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THE FOUNDRY

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A PERMANENT MOLD GRAY IRON FOUNDRY

The use of cast iron molds and cores in the production of soil pipe fittings --- Description of the Tacony Iron Co.'s sandless foundry

SOME four years ago, Edgar Allen Custer, president of the Tacony Iron Co., Tacony, Philadelphia, Pa., began an investigation of the permanent mold problem, and finally selected cast iron as the material offering the greater number of advantages and the least number of disadvantages. Engaged in the manufacture of soil pipe and fittings, Mr. Custer's first experiments were directed toward the production of the larger castings in permanent molds. The continuous casting machine, which was first designed and built, was described in THE FOUNDRY, May, 1908. While the molds were made of cast iron, sand cores were used, and this proved the only objectionable feature of the process. Fittings were next experimented with, but sand cores were found impossible owing to their irregularity of form, and it was practically decided to discontinue further work along this line, when as a last resort, cast iron cores were suggested and tried. From the first the experiments were crowned with success, and the most exasperat-

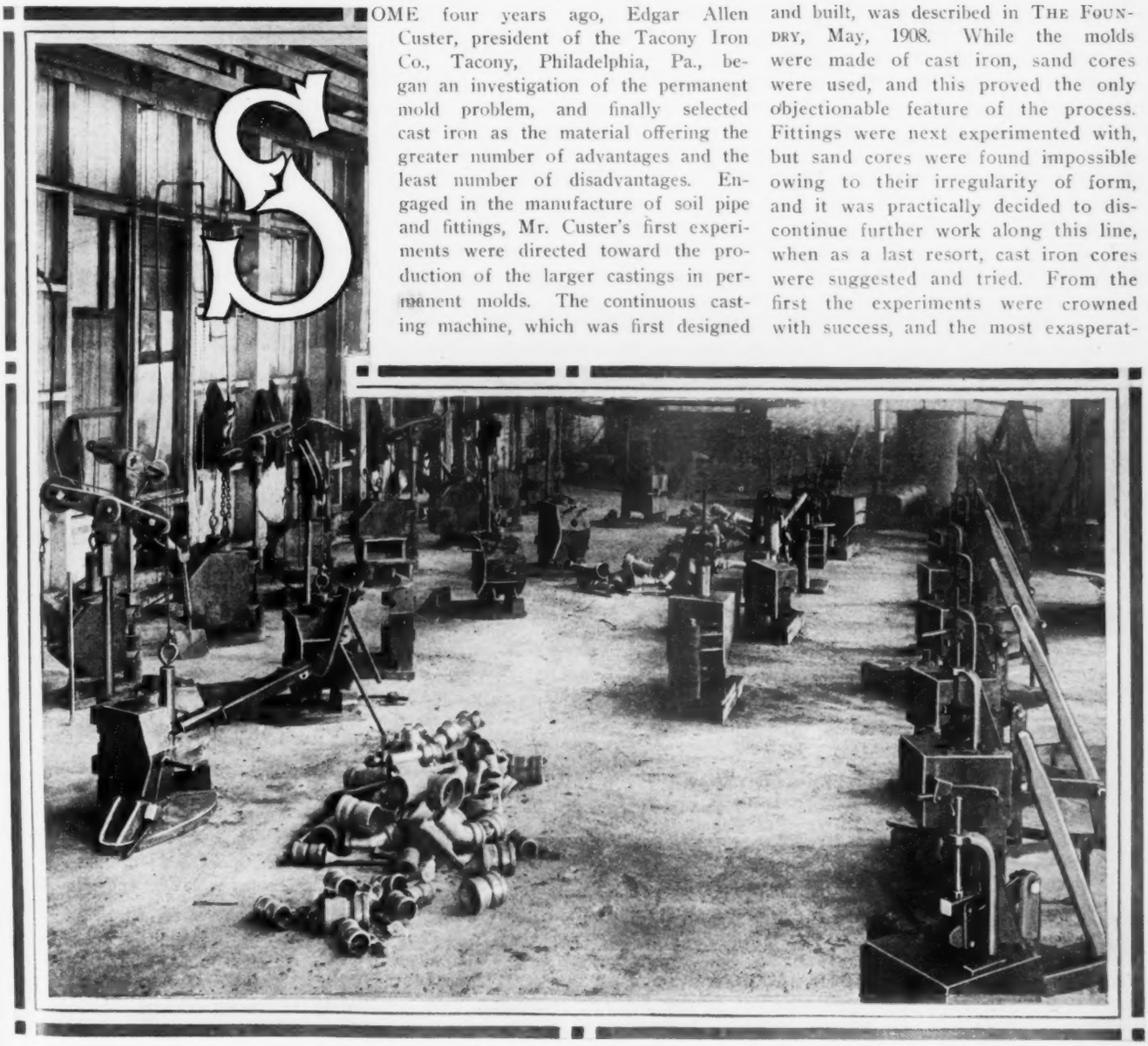

FIG. 1—VIEW OF PERMANENT MOLD DEPARTMENT OF THE TACONY IRON CO., LOOKING TOWARD THE CONTINUOUS SOIL PIPE CASTING MACHINE

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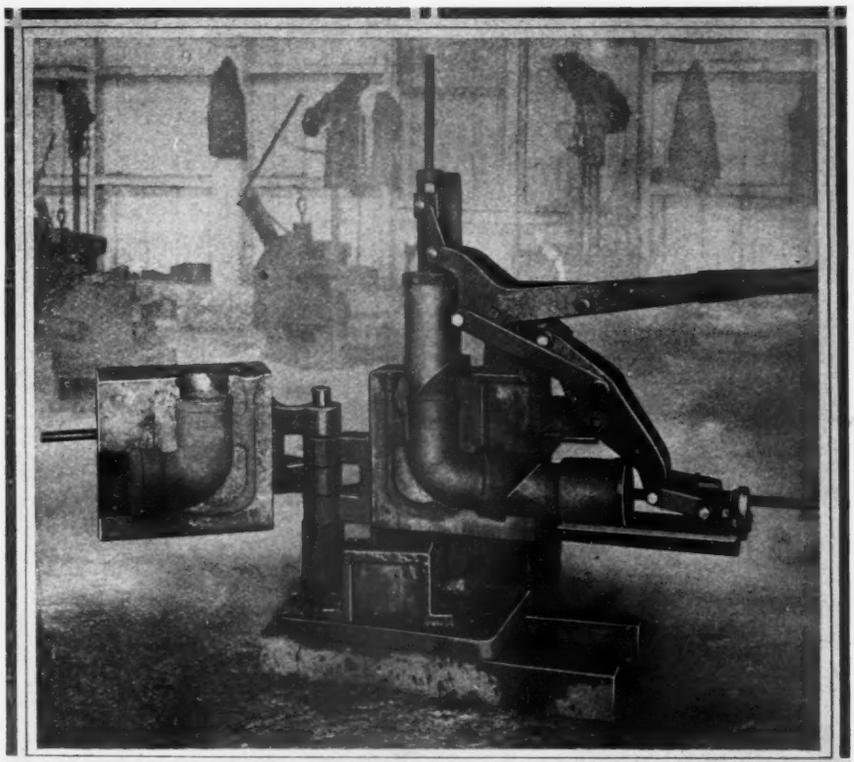


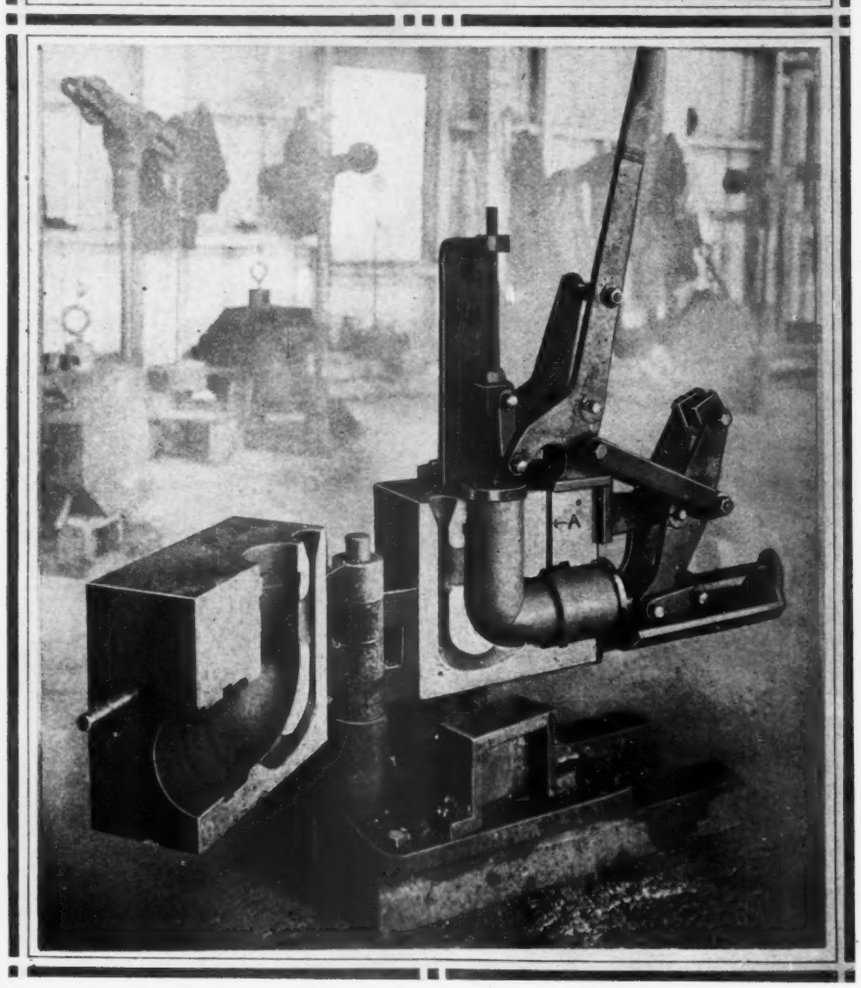


FIG. 2—PERMANENT MOLD FOR A 5-INCH QUARTER BEND. THE CORES HAVE JUST BEEN RELEASED AND THE CASTING IS IN THE HALF OF THE MOLD, WHICH IS SWUNG OUT

FIG. 3—PERMANENT MOLD FOR 5-INCH QUARTER BEND, SHOWING THE CORES IN POSITION FOR CASTING

ing problem of permanent mold work was solved. This discovery upset another of the many traditions of the art of founding, and as yet it is impossible to forecast the scope of its tremendous possibilities. Already, all kinds of cored cast iron fittings are being made in permanent molds equipped with cast iron cores, and molds have been designed for brake shoes, sash weights and various kinds of hardware.

Cost of Permanent Mold Fittings.

At the plant of the Tacony Iron Co. gray iron fittings are now exclusively cast in this way, molds having been installed for the production of quarter and eighth bends, T's, Y's, double hubs, reducers, etc. These castings vary in weight from 4 to 28 pounds, and the average labor cost is approximately 2 cents per casting, as compared with an average molding cost of 6 cents per fitting when made in sand. All of the labor employed in the permanent mold department is unskilled, and a workman can be taught the operation of the molds within a few hours. In addition to the saving in labor cost, the expense of sand and flasks is entirely eliminated, and while against this must be charged the cost of molds and the machines, this amounts to only a fraction of a cent per casting.

Output Per Mold.

It has been estimated that on miscellaneous fittings, covering a wide range of sizes, each mold will have an output of approximately 1,000 pounds of castings daily. Of the smaller fittings, the output per day, in number, will be larger than the heavier fittings, and it is furthermore possible to cast the smaller fittings more rapidly than the larger, as they do not heat the molds so quickly. The temperature of the molds has not been a source of difficulty, although it has been found that when raised to a red heat they deteriorate more rapidly than when the temperature is not high enough to discolor the molds.

Shrinkage of Castings on Cores.

As previously stated in Mr. Custer's articles, published in THE FOUNDRY in September, 1908, and June and August, 1909, "the success of casting in permanent molds lies in swiftly chilling the molten iron to the point at which it is set, and then immediately removing it from the chilling effect and allowing it to cool normally." If the cast iron cores are not removed immediately after the iron

has set, the shrinkage of the iron holds the cores and they cannot be withdrawn. The mold is then opened and the casting is broken with a hammer to release the cores, and the only loss incurred is the labor required in producing the casting. The mold and core are uninjured, and after the casting has been removed, the mold is closed, the cores are lowered into place, and another fitting is cast. The operators, however, soon become sufficiently skilled in their work to accurately determine when the cores should be withdrawn, and the losses from the shrinkage of the castings on the cores are extremely light.

Weight of Molds.

Only ordinary care must be exercised to prevent the castings sticking in the molds, and these, as well as the cores, are coated occasionally with a mixture of thin oil and graphite. While it is almost impossible to formulate any fixed rule as to the size and shape of molds for various castings, a surplus of metal in every case has given excellent results. For castings weighing up to 15 pounds the ratio of weight of mold to casting is 100 to 1, and above 15 pounds about 70 to 1. For a 15 pound casting the mold would weigh 1,500 pounds, and for a 25 pound casting, approximately, 1,750 pounds. The molds and the cores are cast from ordinary gray iron, such as is used for soil pipe and fittings, and in one mold more than 6,000 pieces have been cast without showing signs of deterioration. The time required for making castings in these permanent molds varies with the weight of the casting and the thickness of the section. Small castings can be produced more rapidly than large ones, as the time of set in the larger castings is greater than of those lighter in weight. Plow points, for example, can be cast four per minute, while some of the larger fittings can be made at the rate of one every two minutes.

Permanent Mold Department.

The permanent mold department of the Tacony Iron Co. occupies a space of only 60 x 28 feet, and while only 23 permanent mold machines have been installed, the ultimate equipment will be 60. Additional machines are being added as rapidly as they can be built, and the daily output from this department will be about 30 tons, with an average of 15 pounds per section. A view of the permanent mold foundry is shown in Fig. 1, the continuous permanent mold

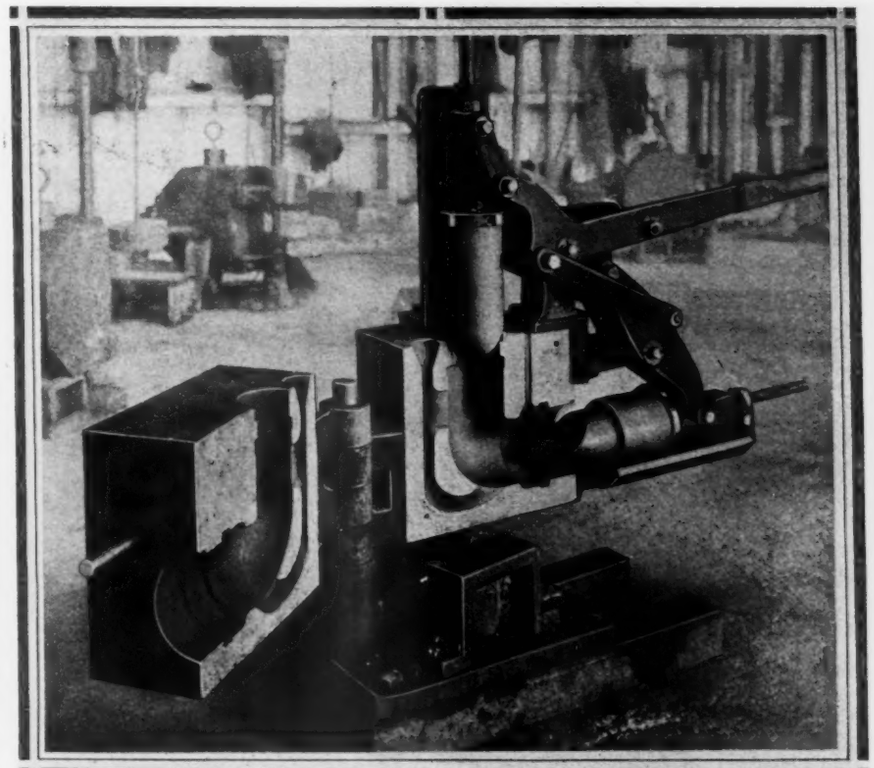


FIG. 4—PERMANENT MOLD FOR 5-INCH QUARTER BEND WITH CORE RELEASED. THIS VIEW CLEARLY SHOWS THE OUTLINE OF THE TWO HALF MOLDS

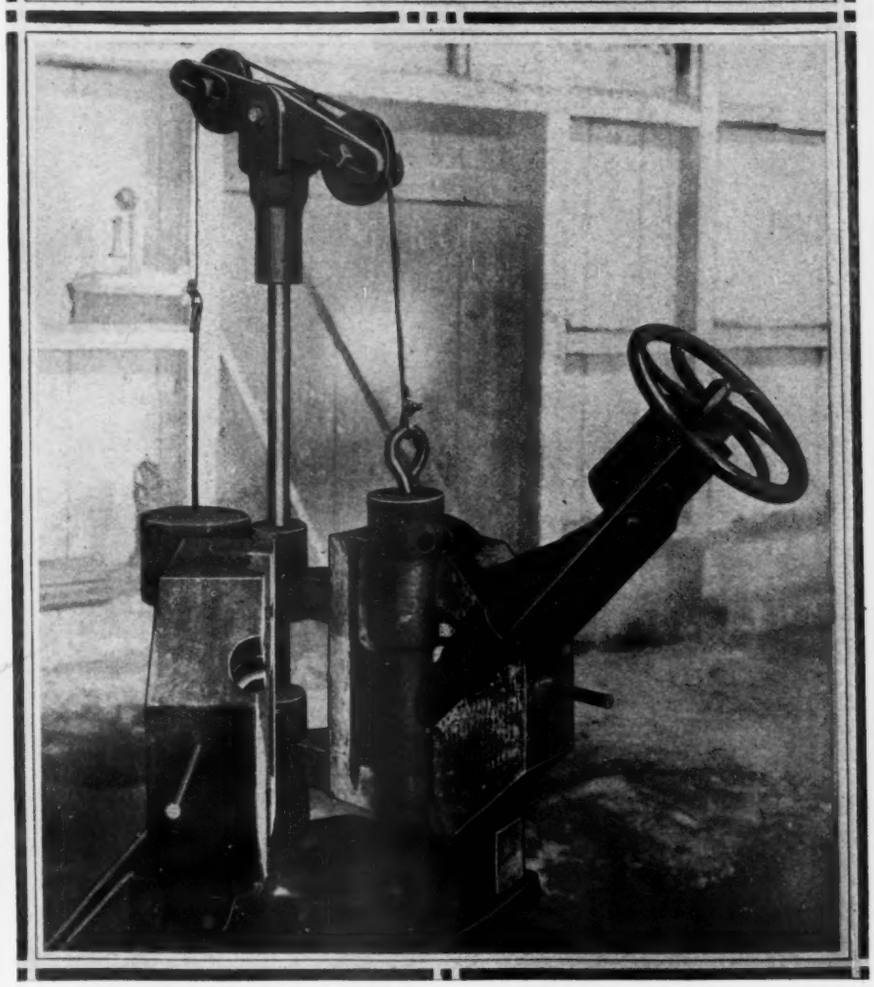
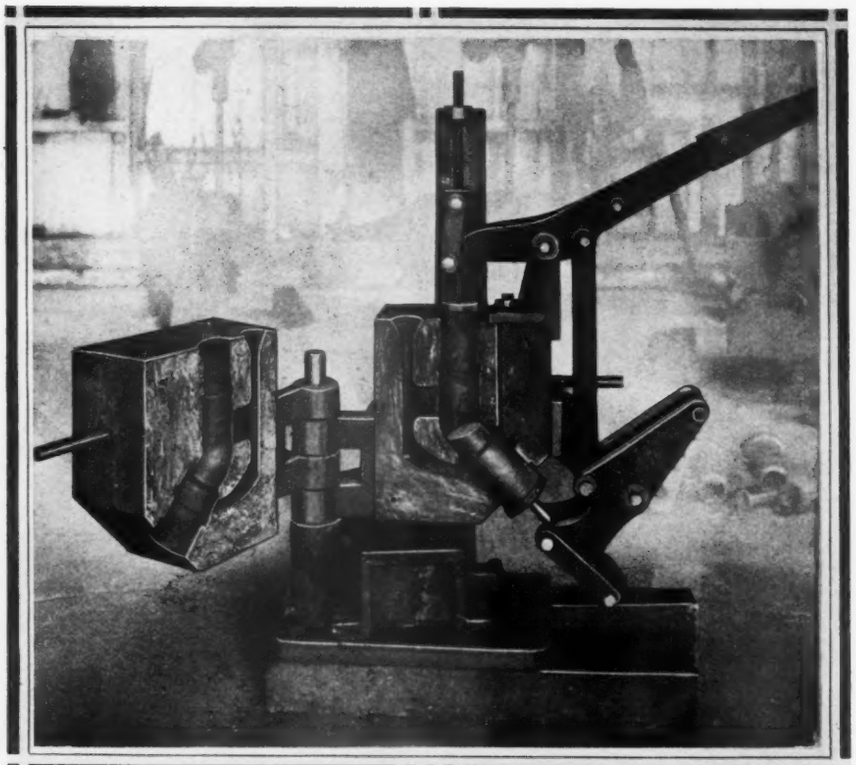


FIG. 5—PERMANENT MOLD FOR A 5 x 3-INCH Y. THE CASTING WEIGHS 28 POUNDS



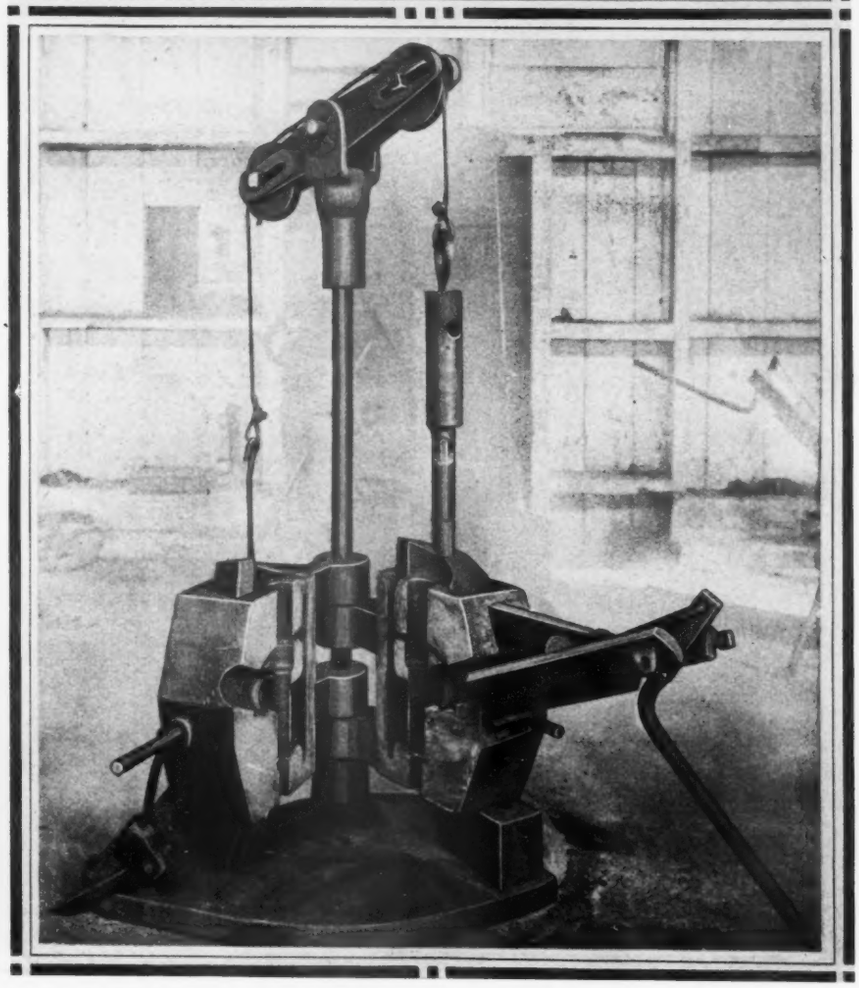


FIG. 6—PERMANENT MOLD FOR A 3-INCH EIGHTH BEND. THE TWO HALVES OF THE CORE ARE SLIGHTLY SEPARATED

FIG. 7—PERMANENT MOLD FOR A 2 x 2-INCH HALF Y

soil pipe machine being in the immediate background, and the hand molding department in which soil pipe is still made in sand molds, is in the rear of this machine.

Permanent Molds for Fittings.

Another view of the permanent mold department, from the opposite end of the plant, is shown in Fig. 10. An overhead track, from which an air hoist is suspended, is parallel to and directly over the row of permanent molds next to the side wall. This hoist is used to withdraw the heavy main cores from large permanent molds for T's and Y's, which are too heavy for the workmen to handle. To facilitate the rapid handling of metal from the cupola to the large molds, a trolley, from which ladles are suspended, is also hung from this track. The cast iron pipe fittings produced in the permanent molds in this department, including their weights, follow:

First row next to the wall, right to left: 2 x 4-inch increaser, 10 pounds; 4 x 2-inch T, 14½ pounds; 4 x 2-inch Y, 18 pounds; 4 x 2-inch tapped T, 16 pounds; 4 x 4-inch T, 23 pounds; 4 x 4-inch Y, 25 pounds; 3 x 3-inch Y, 19 pounds; 5 x 3-inch Y, 23 pounds, 4 x 3-inch Y, 21 pounds.

Second row: 4 x 3-inch increaser, 13 pounds; 4 x 2-inch half Y, 15 pounds; 3 x 2-inch tapped T, 10 pounds; 2 x 2-inch Y, 8 pounds; 3 x 2-inch Y, 15 pounds; 2 x 2-inch half Y, 8 pounds. The complete equipment of the second row will include 15 machines, nine more to be added as soon as the machines and the permanent molds can be built.

Third row: 3-inch eighth bend, 8 pounds; 2-inch quarter bend, 5 pounds; 5-inch quarter bend, 22 pounds; 4-inch eighth bend, 13 pounds. Seventeen additional machines for bends of different sizes are still to be installed in this row.

Fourth row: 4 x 3-inch reducer, 7 pounds; 3 x 2-inch reducer, 5 pounds; 5 x 3-inch reducer, 8 pounds; 4 x 2-inch reducer, 8 pounds; 5 x 4-inch reducer, 11 pounds; 4-inch double hub, 10 pounds; 2-inch double hub, 4 pounds. The latter is the lightest casting produced in this department.

Operation of Permanent Molds.

The operation of the permanent molds on all of these machines is similar, in that one-half of the mold is fixed, while the other half swings on a hinge. The construction of the cast iron cores, of course, varies as well as the method of their withdrawal from the molds. A machine for

molding 5-inch quarter bends is shown in Fig. 2. One-half of the mold is swung out, operating on a hinge, while the other half is stationary. The levers for operating the cores are attached to the fixed mold side of the machine. In this view the casting has just been poured, and the two halves of the core have been withdrawn by depressing the operating lever. Immediately after the withdrawal of the cores, the movable half of the permanent mold is swung out, permitting the removal of the casting. In this instance the casting has been permitted to remain in this half of the mold, the gates, runner and sprue being clearly shown. It will be noted that while the two halves of the core are curved to conform to the shape of the mold, the arbors on the outside edge are straight to permit of their easy withdrawal from the mold. A view of the two halves of the core closed together in the position they assume when the mold is closed, and while the metal is being poured, is shown in Fig. 3.

The half of the permanent mold at the left is without imperfections, despite almost constant use for several months. It would naturally be supposed, that at the point where the cores meet, a fin would be formed in the casting. This, however, is not the case, as the iron sets so rapidly that it does not rise into this space.

Venting the Molds and Cores.

At *A*, Fig. 3, is shown a vent, which is provided to permit the air in the mold to escape, and the cores are drilled to permit of the passage of air into the mold when the cores are released. Before these openings were made in the cores, it was found exceedingly difficult to withdraw the two halves, owing to the formation of a vacuum, which held the core together. However, when the two halves of the core are separated, air rushes in through these passages and overcomes the atmospheric pressure. Another view of these cores, withdrawn from the mold, is shown in Fig. 4. The fixed half of the permanent mold can also be clearly seen, and it will be noted that its surface is still as perfect as when it was received from the machine shop.

End and side elevations of a machine equipped with permanent molds for quarter bends are shown in Fig. 1. The side elevation is a view of the fixed half of the permanent mold, and the method of bolting this half of the mold to the base is clearly illustrated. The four parts of the hinge

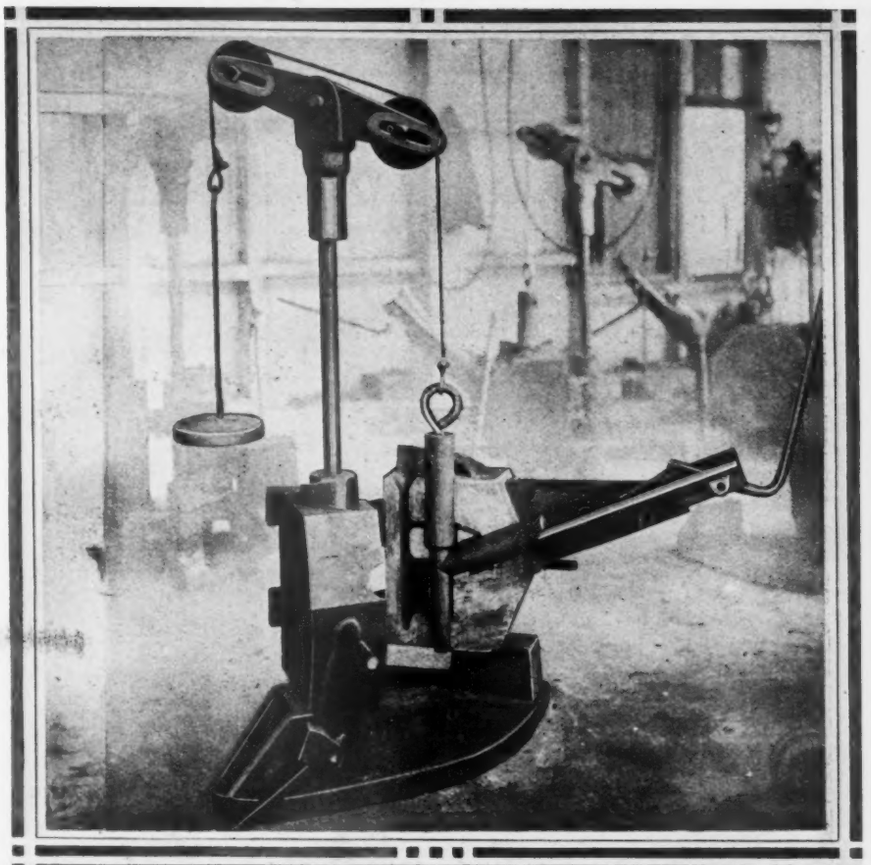


FIG. 8—PERMANENT MOLD FOR A 2 x 2-INCH Y, SHOWING THE CORES IN CASTING POSITION

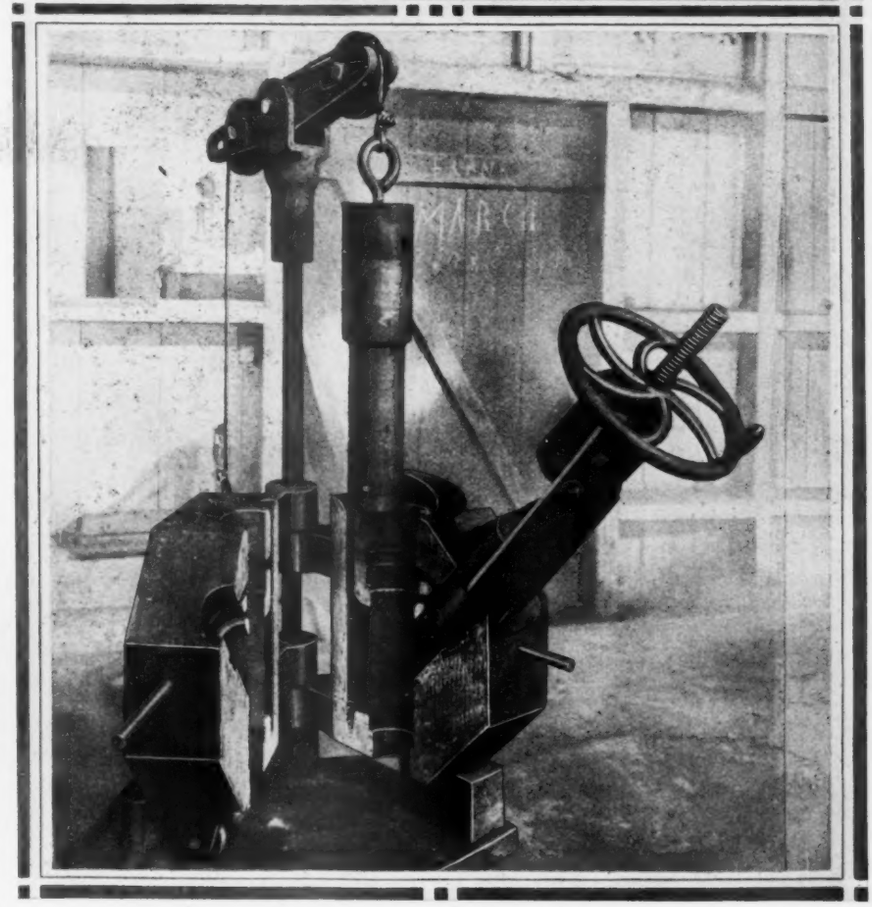


FIG. 9—PERMANENT MOLD FOR A 5 x 3-INCH Y, SHOWING THE CORES RELEASED

FIG. 10—GENERAL VIEW OF THE TACONY IRON CO.'S PERMANENT MOLD FOUNDRY FOR THE PRODUCTION OF SOIL PIPE FITTINGS

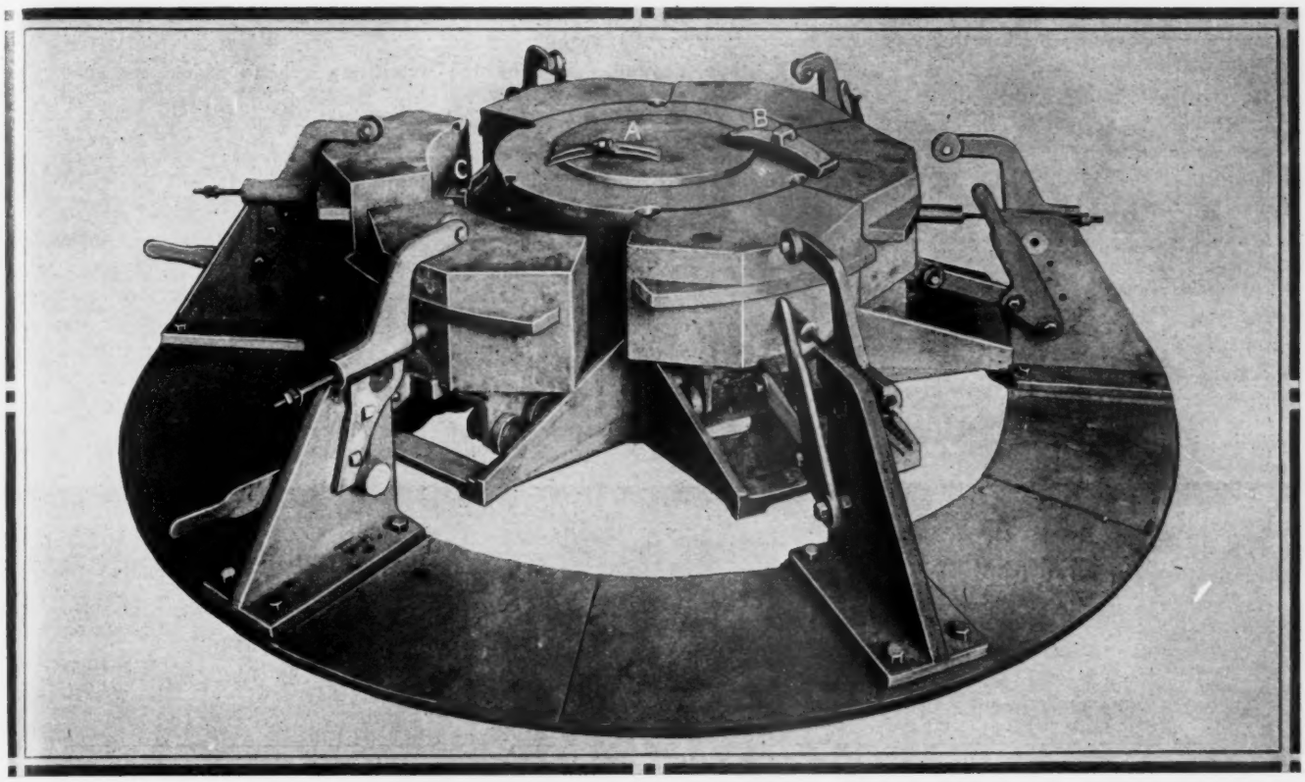


FIG. 11—SPECIAL PERMANENT MOLD MACHINE FOR CASTING BRAKE SHOES. THIS MACHINE IS EQUIPPED WITH SIX MOLDS, AND THE CASTINGS ARE POURED CONTINUOUSLY

on which the movable half of the mold swings are also shown. The release of the cores is accomplished by two sets of compound interlocking levers.

A machine equipped with a permanent mold for a 3-inch eighth bend is shown in Fig. 6, and end and side elevations in Fig. 18. While the lower half of the core of the quarter bend mold, shown in Figs. 2 and 4, is drawn out horizontally owing to the 90 degree angle, in the eighth bend molds

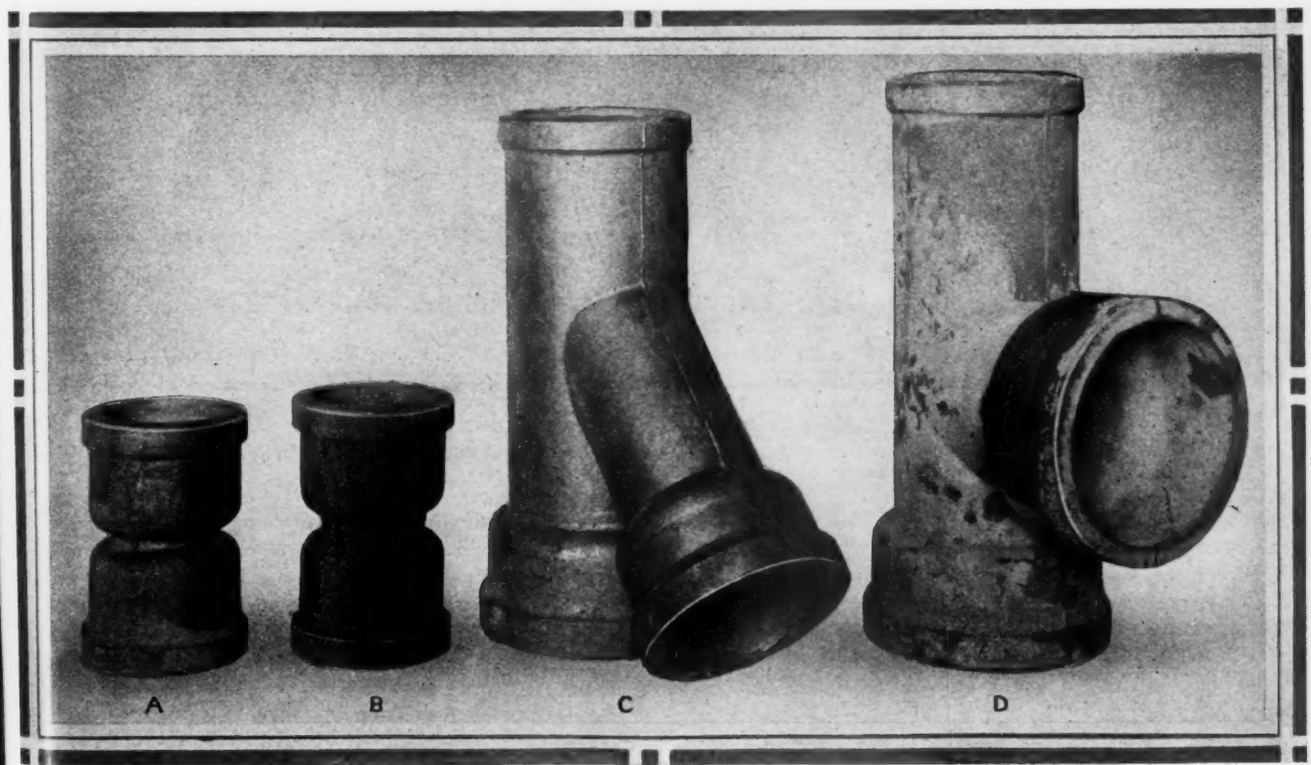


FIG. 12—THE RESISTANCE OF PERMANENT MOLD CASTINGS TO CORROSION IS CLEARLY SHOWN BY THE DOUBLE HUB *A*, WHICH WAS CAST IN A PERMANENT MOLD; *B* WAS SAND CAST. CASTING *C* WAS ALLOWED TO CHILL IN A PERMANENT MOLD AND *D* IS SOFT, ALTHOUGH SIMILARLY CAST. IT WILL ALSO BE NOTED THAT *D* SHOWS SIGNS OF CORROSION, WHEREAS *C* PRESENTS PRACTICALLY AN UNPITTED SURFACE

it is drawn out at an angle to the upper half by the same compound lever movement which releases the cores in the quarter bend molds. In this case again it will be seen that the curve of the core follows the curve of the the mold, but the outside edge of the arbor is straight. The core is slightly separated to show the diagonal joint which saddles at the angle of the core. Heretofore the two halves of the core were slotted together, but the diagonal joint has been found preferable.

Molds for Y's and T's are all made with the cores independent of the machine. A permanent mold for a 2 x 2-inch half Y is shown in Fig. 7. One-half of the mold swings on a hinge, and a roller is attached to the bottom of this mold at the outer end to support it, owing to its great weight. This roller operates on the cast iron base of the machine. The main body core, shown raised out of the mold, is counterweighted, the wire rope connecting the counterweight to the core passing over sheaves on the arm, which is free to swing around on the post by which it is supported. This construction permits the main body core and arbor to be swung out of the way when desired. The branch core is drawn out of the casting by depressing a lever, which is shown lowered in Fig. 7, and elevated in Fig. 8. The main and branch cores fit together with a tongue and groove joint, the tongue on the main core being clearly shown in Fig. 7. In Fig. 8 the main core has been lowered and is in the position it assumes when the mold is closed, the branch core also being shown in place. A clamp is shown in both Figs. 7 and 8, on the bar of the movable half of the permanent mold by which the two halves of the mold are held firmly together when the same is closed and the metal is poured. The branch core moves in a V-shaped slide, at the end of which a lever is attached for releasing the core from the casting.

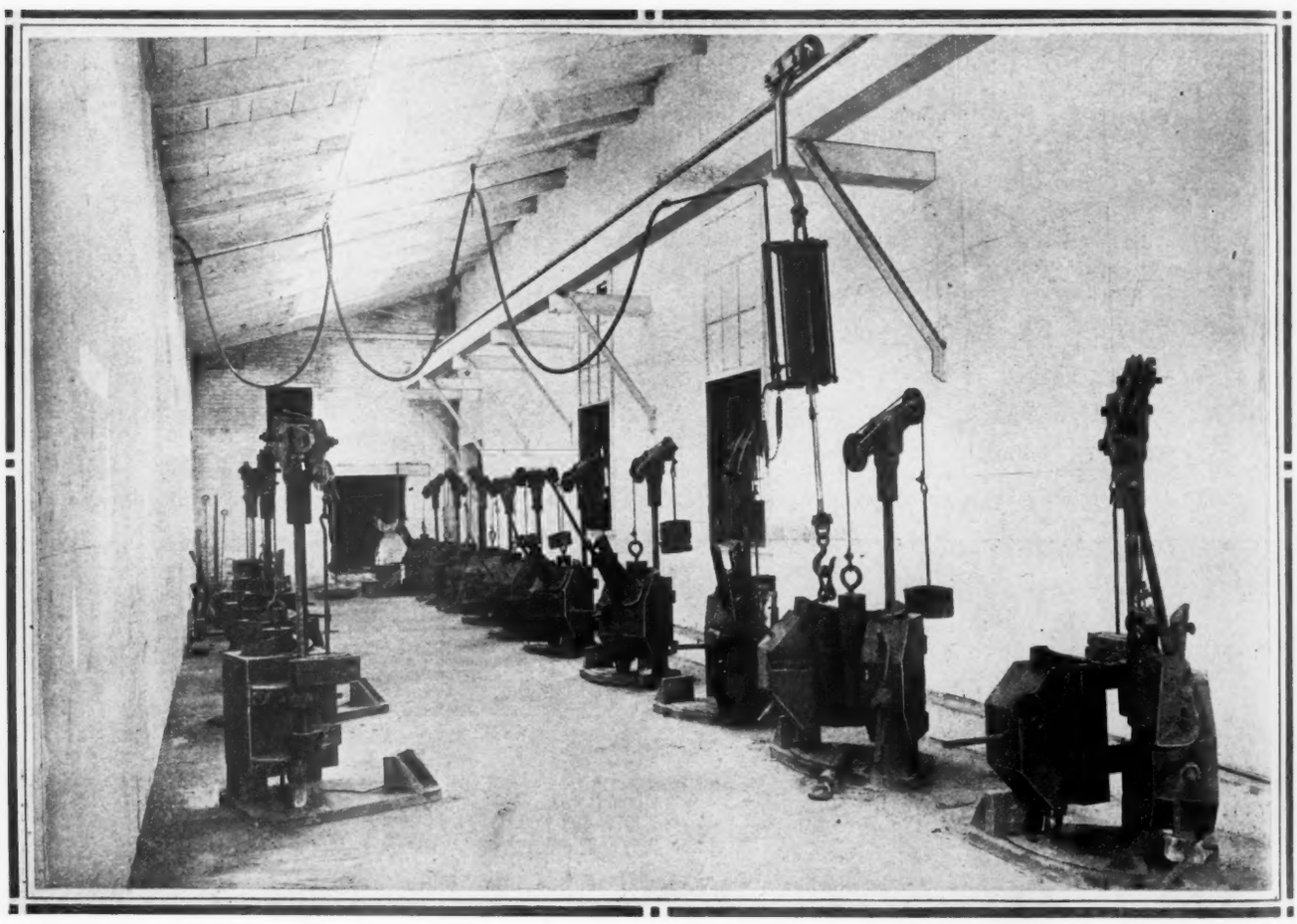


FIG. 13—FIRST INSTALLATION OF PERMANENT MOLD MACHINES FOR FITTINGS AT THE PLANT OF THE TACONY IRON CO. THE MACHINES WERE REMOVED FROM THIS ROOM TO THE DEPARTMENT SHOWN IN FIG. 10

Mold for a Large Fitting.

A machine equipped with a large permanent mold for a 5 x 3-inch Y fitting, weighing 28 pounds, is shown in Figs. 5 and 9. The main core is counterweighted, while the branch core is released from the casting by operating a hand wheel, the arbor being attached to a screw. In Fig. 5 the main and branch cores are shown in the position they assume when the mold is closed. It will be noted that the branch core is curved at the end to conform to the curved surface of the main core, thus doing away with the tongue and groove joint. Otherwise, this machine is similar in construction to that shown in Figs. 7 and 8. Owing to the great weight of the main cores of large Y fittings, an air hoist is generally used to withdraw these cores from the castings. This arrangement is clearly shown in Fig. 19, which is a side elevation of a machine for branch fittings, showing an outline of the mold in dotted lines. The hook on the air hoist engages a hooked bar, which passes through an eye on the main core. The arrangement of the counterweight is clearly shown, as well as the sheaves and the arm.

Molds for Reducers.

The machines equipped with molds for reducer fittings are similar in con-

struction to the machines for producing quarter and eighth bends. One-half of the mold is stationary, while the other half is hinged and is swung out to release the casting. The cores are released by levers, both upper and lower cores being raised and lowered out of the mold vertically.

The first installation of these machines in the plant of the Tacony Iron Co. is shown in Fig. 13. The room in which they were located, however, proved too small, and to provide more space for additional equipment a larger room was obtained. This, however, clearly shows the application of the reducer castings are made. The cores are in halves, the upper half being raised and the lower half being lowered vertically out of the casting.

Sash Weight Molds.

Four special permanent molds for sash weights, located in a room adjoining the main permanent mold department, are shown in Fig. 15. These molds were constructed for producing a patented sash weight, which are cast two in a mold, and are made in 7, 8, 9 and 10-pound sizes. One-half of the mold is moveable, being supported on four rollers, while the other half remains fixed. The name of the inventor of these weights is reproduced on each casting, and to obviate the necessity of chiseling the name on each mold, two name plates are carried on arbors in each mold, one for each weight. The second mold in this view is shown closed, and the support for the name plate arbors can be seen at *A*. In addition, one hole must be made in each weight. In the second mold these two arbors are shown in position, while on the first mold they are shown resting on top of the movable half. When the metal has been poured into the mold the two arbors, which make the holes in each weight, are immediately withdrawn, and when the movable half of the mold is moved back by the double levers, the arbors carrying the name plates remain stationary, and thereby push the castings out of the mold. In this operation the movable half of the mold draws the casting out of the fixed half for a very short distance, and from that point the arbors, which act as plungers, push the casting out of the other half of the mold. These castings can be made at the rate of 10 per minute, without unduly heating the molds.

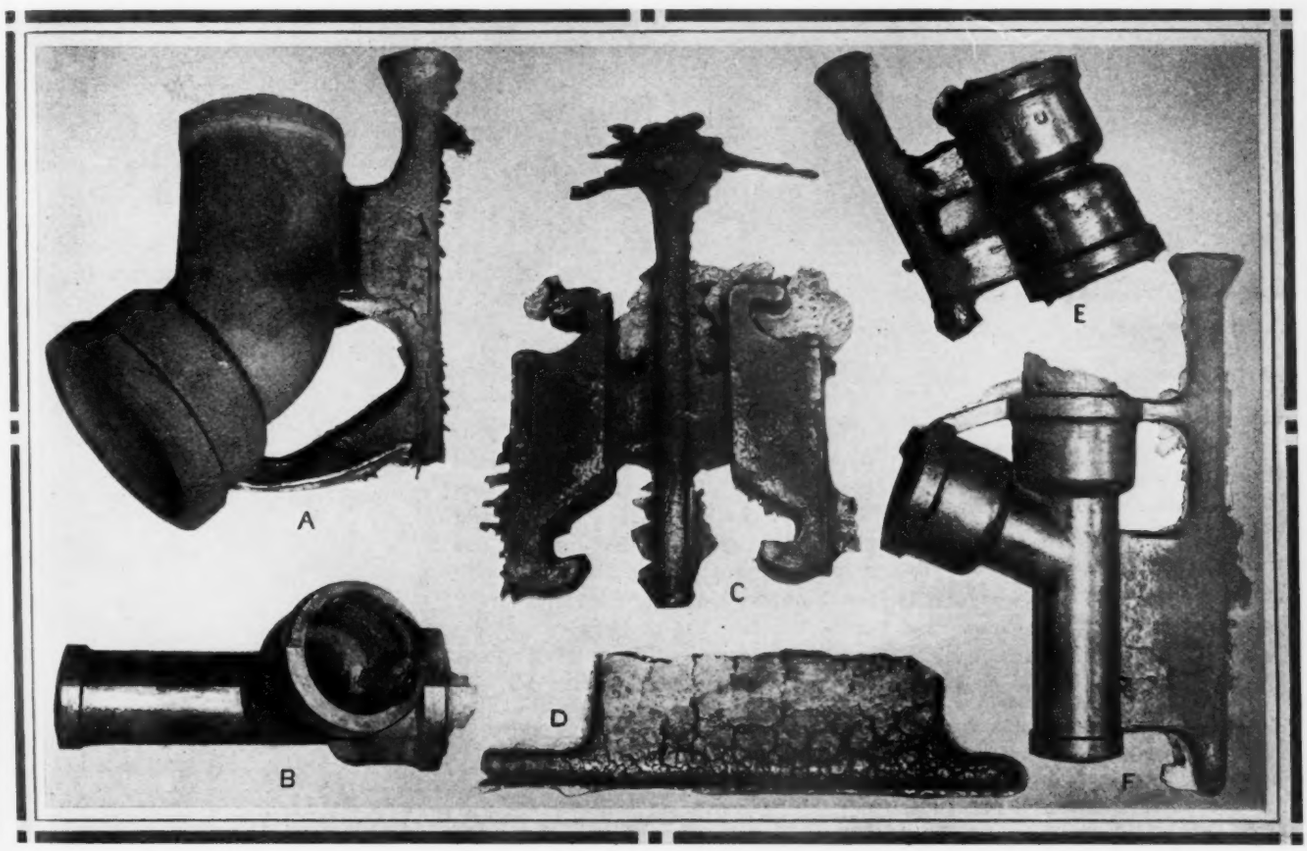


FIG. 14—THE METHOD OF GATING A 4-INCH EIGHTH BEND IS SHOWN AT *A*; *B* IS A CASTING WHICH BLED IN THE BRANCH BELL; *C* SHOWS SASH WEIGHTS WITH HEAVY FINS DUE TO THE WEAR OF THE PERMANENT MOLD, WHICH HAS BEEN USED FOR THOUSANDS OF CASTINGS; *D* IS A BADLY SCORED RUNNER; *E* SHOWS THE METHOD OF GATING A DOUBLE HUB; *F* IS A 2 x 2-INCH HALF Y, SHOWING CONTRAST BETWEEN HARD AND SOFT IRON IN THE SAME CASTING

air hoist for the removal of the main cores.

For withdrawing the branch cores from large T fittings, a bar is inserted in an eye in the arbor of the branch core, as shown in Fig. 19. This core is withdrawn straight from the mold, while the main core and arbor are lifted out of the casting by an air hoist.

Molds for Double Hubs.

The operation of machines equipped with permanent molds for double hubs is similar to that of machines on which

Two of these sash weights are shown at *C*, Fig. 14. It will be noted that the fins are unusually heavy. This is due to the long continued use of the molds, which are now becoming slightly worn.

Permanent Mold Brake Shoe Machine.

A special machine for casting brake shoes in permanent molds is shown in Fig. 11. It consists of six molds, two of which are open, and the remainder are closed and in the position they assume when the metal is being poured. The break shoes have steel backs, *A*,

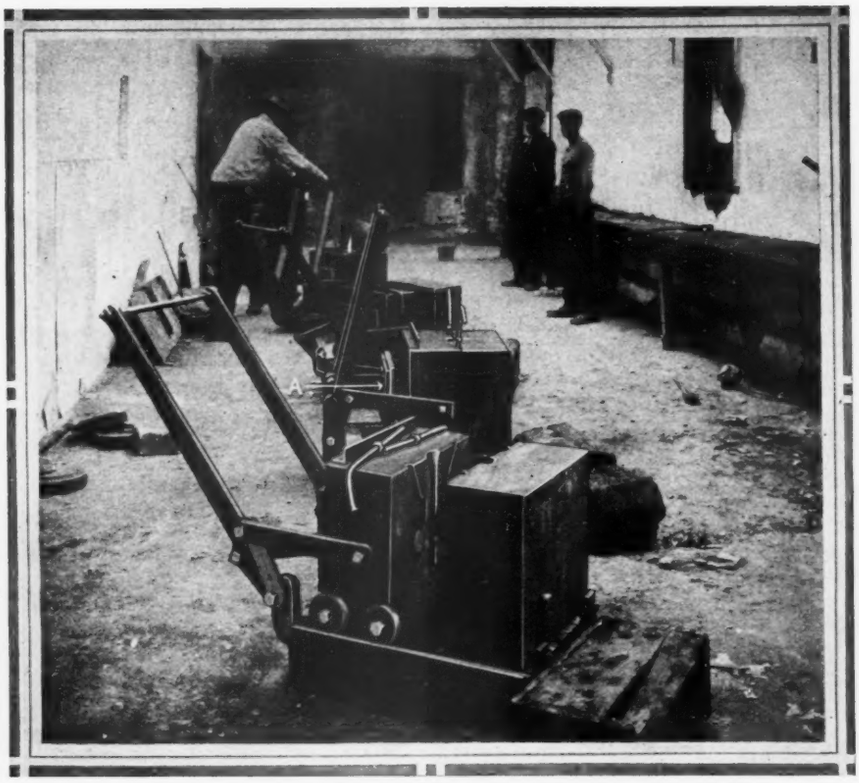


FIG. 15—FOUR PERMANENT MOLD SASH WEIGHT MACHINES

while the casting is shown at *B*. The movable halves of these molds are carried on rollers and are opened and closed by hand levers. The steel back against which the brake shoe is cast is held in a groove in a movable steel carrier at the end of a plunger. When the projection in the steel back is inserted in the groove in the carrier and the mold is closed, the steel back is in the horizontal position shown at *C*. However, when the brake shoe is cast onto the steel back and the mold is opened, the weight of the casting tilts the carrier, and the brake shoe, by its own weight, drops out of the mold. In operation, the steel back is inserted in the groove in the carrier, a metal core is set in place and the mold is closed by the upward movement of the hand lever. This operation also actuates the plunger carrying the steel back, which is drawn back into place into the movable half of the permanent mold. After the metal has been poured, the mold is opened by depressing the hand lever. The plunger, carrying the steel back against which the brake shoe has been cast, withdraws the casting from the fixed half of the mold, and then moves forward, releasing the steel back from the movable half of the permanent mold, thereby permitting the casting to drop away from the mold, as previously described.

Operation of Brake Shoe Molds.

This machine is operated by four men, while the fifth pours the metal continuously. The first operator puts the steel back in the carrier and places the core in the mold. The second operator closes the mold with the lever, and after an interval of 10 or 12 seconds, the mold is opened by another operator. The next operation is to adjust the carrier for the steel back, and the sequence of operations is repeated. The machine is 7 feet in diameter, while the center piece, which is a solid casting, is 3 feet in diameter, 2 feet high, and weighs 7,000 pounds.

Permanent Mold Castings Resist Corrosion.

Experiments indicate that castings made in permanent molds resist corrosion for a greater period than those cast in sand. Two double hubs shown at *A* and *B*, Fig. 12, were exposed in an open shed for a period of 30 days. The sand cast hub, *B*, is pitted over its entire surface, while the casting, made in the permanent mold, at *A*, shows only slight traces of corrosion. This is undoubtedly due to the closer grain of the metal of castings made in permanent molds as compared with those cast in sand. Experiments also show that castings permitted to chill in the molds, and thus obtain a highly polished surface, which in many cases assumes the appearance of having been nickel-plated, resist corrosion better than castings which have been dropped out of the molds immediately after the iron has set, and which are, therefore, soft. A so-called, hard permanent mold casting is shown at *C*, while at *D*, a soft permanent mold casting, which shows traces of corrosion is illustrated. Both have been exposed to the weather in an open bin, but the casting at *C* has developed only slight traces of corrosion.

In Fig. 17 is shown one-half of a permanent mold for a 5 x 4-inch T Y fitting. It will be noted that the branch is slightly curved and the cast iron core will have to describe an arc of a circle conforming to this curved surface when being withdrawn from the mold. These molds are made from ordinary gray iron, being cast with the face in

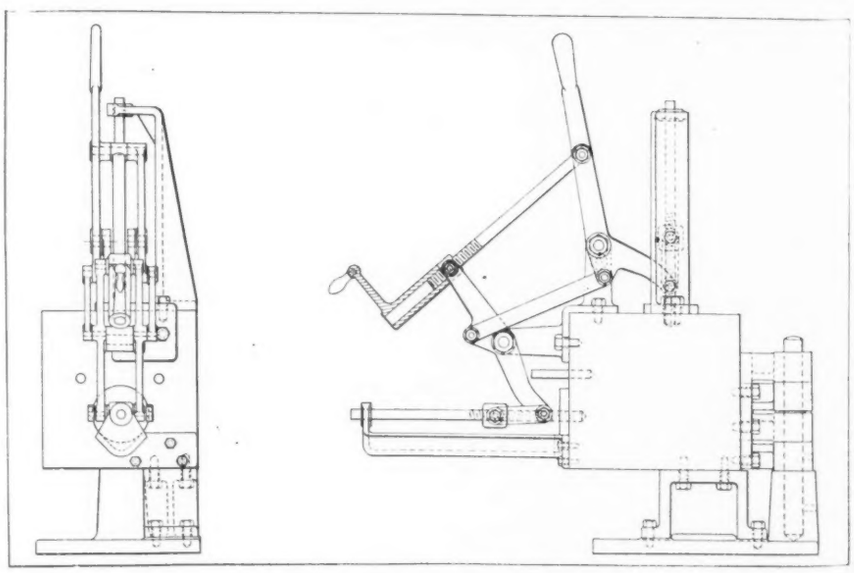


FIG. 16—END AND SIDE ELEVATIONS OF MACHINE EQUIPPED WITH A MOLD FOR QUARTER BENDS

the drag, and the patterns are milled out in the machine shop.

Effect of Hot Iron on the Runner.

The effect of a badly scored runner and gate of a permanent mold is shown at *D*, Fig. 14. Several thousand castings were made in this mold before the runner become furrowed, and this is more pronounced in the runner as it receives the full effect of the molten iron at its highest temperature. The gate itself is only slightly scored, while the mold proper has as yet shown no signs of deterioration. Nor is it necessary to discard the molds after they have become furrowed from repeated use. The defective portion is machined out, and a block of cast iron is fitted in place, which is bolted to the mold, the bolts passing entirely through the same, being fastened with nuts at the back. This cast iron block is then machined to conform to the shape of the defective portion of the mold that has been cut out.

Hard and Soft Iron in One Casting.

At *F*, Fig. 14, is shown a 2 x 2-inch half Y, and in this casting the contrast between hard and soft iron is marked. The gate and riser are soft and have a dull gray appearance, while the casting itself is hard, and has a gray metallic luster. It will also be noted that the branch and main section of the fitting are gated together at their bell ends to facilitate the flow of the metal in the branch. Early experiments showed that unless this was done, distinct lines would develop in the main section of the fitting, resulting from the iron flowing into the branch and continuing its flow in the main after the branch had been filled.

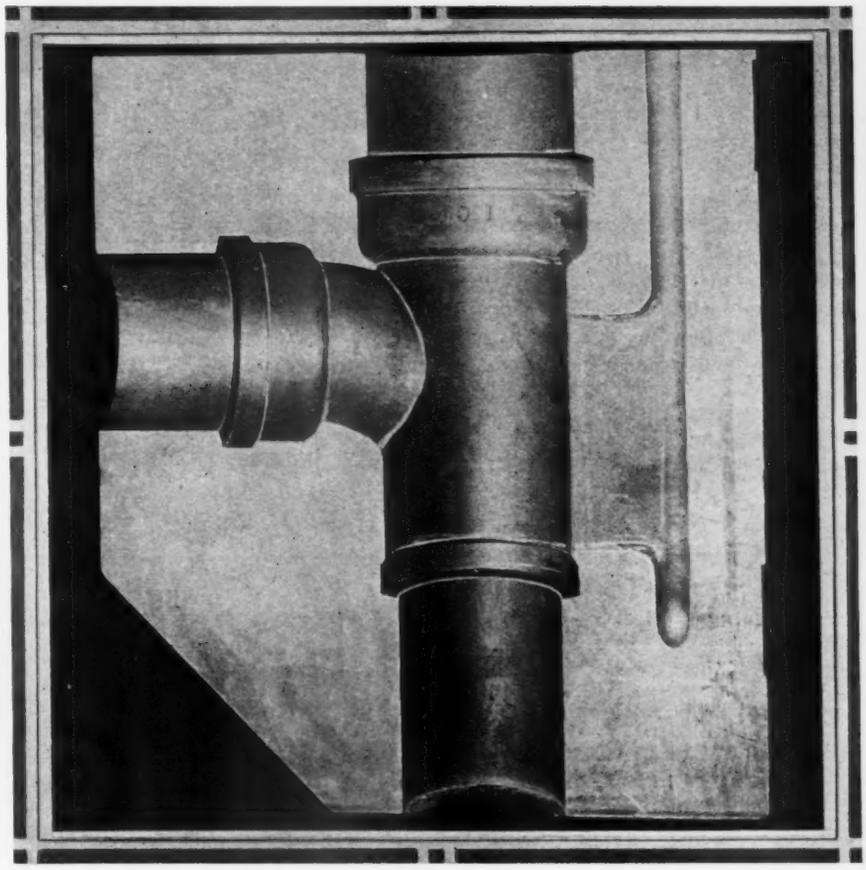


FIG. 17—ONE-HALF OF A PERMANENT MOLD FOR A 5 x 4-INCH T Y. THE BRANCH IS SLIGHTLY CURVED

Effect of Prematurely Withdrawing the Core.

A casting from which the core was withdrawn before the metal had set is shown at *B*, Fig. 14. It will be noted that it bled in the bell of the branch at the point where the gate from the main fitting leads to this part of the casting. The iron in the runner was still molten when the casting was removed from the mold and flowed through this gate into the branch when the core was withdrawn. The method of gating a 4-inch eighth bend as well as a 2-inch double hub is shown, respectively, at *A* and *F*, Fig. 14.

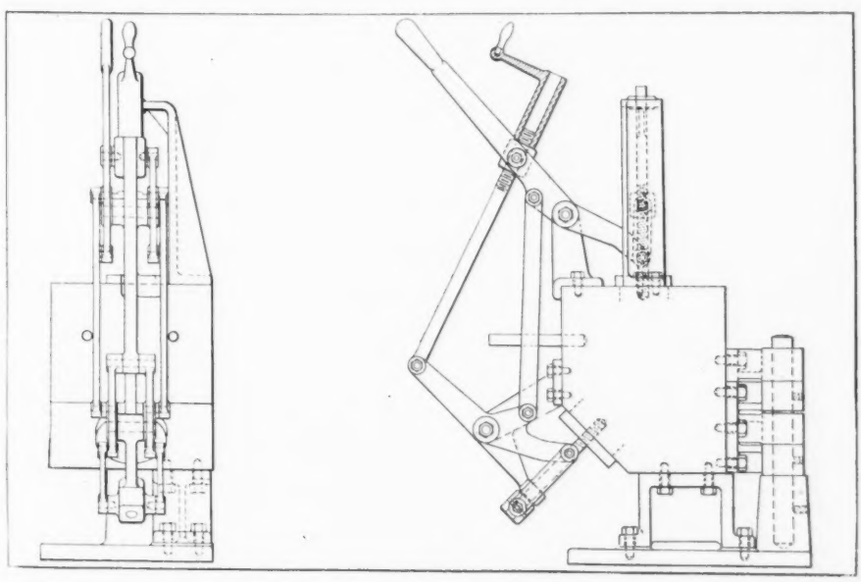


FIG. 18—END AND SIDE ELEVATIONS OF A MACHINE EQUIPPED WITH A PERMANENT MOLD FOR EIGHTH BENDS

Sectional Sash Weights.

A sash weight of novel design, and the apparatus and permanent mold in which it is made, are shown in Figs. 20 and 21. It was devised by E. A. Custer of the Tacony Iron Co., and is a marked departure from the type of sash weights now in use. For windows of ordinary size the sash weights used are made of cast iron, either round or rectangular, with an eye in one end. The weights for large windows in modern office buildings weigh anywhere from 70 to 500 pounds, and it is obvious that a greater flexibility in the weights for counter-balancing is necessary. Single weights, if made in all the various sizes, would be exceedingly cumbersome, and a large variety of weights and lengths would have to be kept in

stock. It is to supply this need that the various styles of sectional sash weights have been designed.

The main requirements of sectional sash weights are that the weights of parts shall be such that any weight can be obtained by a combination of sections. They are usually made in sizes weighing 7, 8, 9 and 10 pounds, and with these four sizes any weight above 14 pounds can be obtained. Another requirement is that any piece may be used for the top, and to this end, all are provided with means for

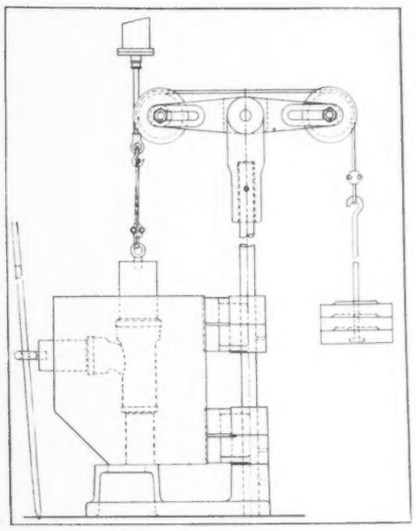


FIG. 19—SIDE ELEVATION OF MACHINE EQUIPPED WITH PERMANENT MOLD FOR A LARGE T Y FITTING. THE MAIN CORE IS LIFTED OUT OF THE MOLD BY AN AIR HOIST, AND THE BRANCH CORE IS DRAWN OUT BY THE BAR AT THE LEFT

attaching cord or chain. Again, each part must be suspended from the one above in such a manner that it is impracticable for it to become unhooked and drop off, or get out of line with the other sections. Various styles of hooks have been used for this feature, but the loss of weight by open spaces at the joints is a serious drawback, as there is seldom length enough in the weight boxes to accommodate the extra length made necessary by the open spaces at the joints. It is also essential that when a string of weights is suspended from their hanging cord, they shall hang in practically a straight line, and that the sections can be hung into one another in the weight box, rather than being hooked together outside and then hung as a unit.

Design of Sectional Sash Weight.

All of these objections have been overcome in the weight, front and

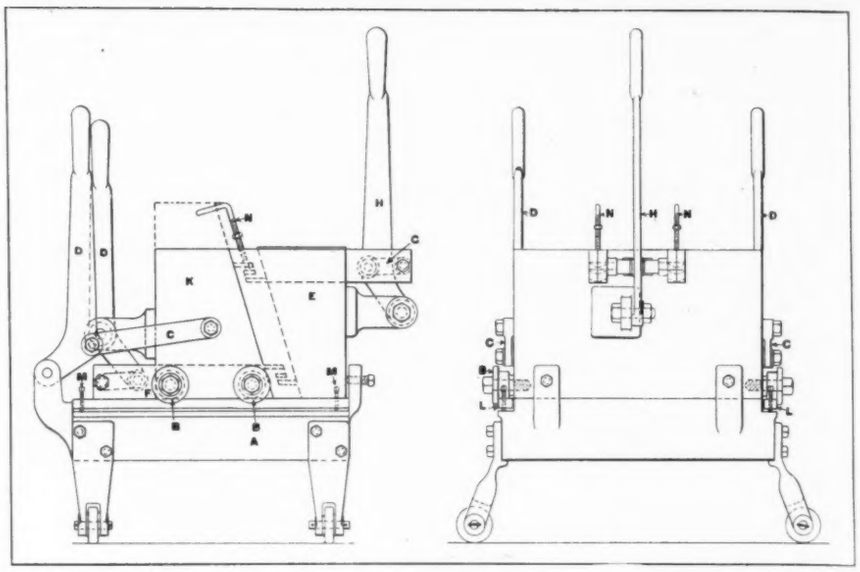


FIG. 20—SIDE AND END ELEVATIONS OF SECTIONAL SASH WEIGHT MOLDING MACHINE EQUIPPED WITH A PERMANENT MOLD

side elevations of which, *A* and *B*, are shown in Fig. 21. The weight consists of rectangular cast iron sections of various sizes, each section being provided at each end with a V-shaped hook set at an angle with the axis of the weight. It will readily be seen that the lower end would fit into the upper end without loss of weight by the open spaces, and inasmuch as the length of hook *C*, Fig. 21, is considerably greater than the excess room in the boxes, it cannot become unhooked after being placed therein. The V-shaped hook prevents any sidewise displacements, and the angle of the hook is such that the various sections have a tendency to hug into their place. It is impossible to unhook them by very violent shaking or swinging. One end of each section is provided with an eye through which chain or rope may be passed for hanging.

The Sash Weight Mold.

The mold used is entirely of cast iron, no sand being required for any part. One portion of the mold is fixed on base *A*, Fig. 20, while the other portion is mounted on rollers *B*, and is arranged with links *C* and levers *D*, so as to be moved to or from the fixed portion *E*, Fig. 21. The parting line between the two portions is at such an angle as will bring the upper and lower surfaces of the casting to a horizontal line, or parallel to the top and bottom of the mold. As will be seen from *D*, Fig. 21, the parting line is not in a plane, but is offset in such a manner that the parting is in effect across the corners of the casting. The end hooks are formed by iron cores *F*, Fig. 20, the lower set being carried in a groove in the movable part, and the upper set in the fixed section.

The Cores.

Each set of cores is provided with links *G* and levers *H*, so that they can be drawn back from the interior of the mold or forced ahead into the position as shown. The gate and sprues

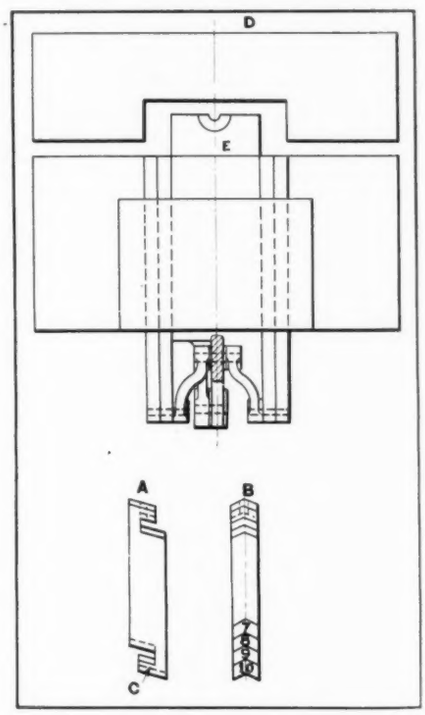


FIG. 21—PLAN VIEW OF THE SECTIONAL SASH WEIGHT MOLDING MACHINE IS SHOWN IN THE UPPER ILLUSTRATION. THE SECTIONAL SASH WEIGHT CASTINGS ARE SHOWN AT *A* AND *B*

Two Handsome Silver Loving Cups for the Best Exhibits at the Foundrymen's Convention in Detroit

The exhibitions of foundry supplies and equipment conducted by the Foundry and Manufacturers' Supply Association during the week of the annual conventions of the various educational societies of the foundry trade, have become features of these meetings that attract foundrymen from all over the world.

The first extensive exhibit was made in Cleveland, in 1906, and then followed the successful expositions in Philadelphia, Toronto and Cincinnati.

Detroit has been chosen for the 1910 convention, and during the week of June 6, makers of equipment and supplies for the foundry trade will display their products in the beautiful City of the Straits.

Thousands of dollars are spent by the exhibitors to make these shows attractive, and their educational value cannot be measured.

In recognition of the magnificent work of the members of the Foundry and Manufacturers' Supply Association, and to arouse further interest in these exhibitions—

***Two handsome silver loving cups** will be presented by THE FOUNDRY to the firms making the best exhibits in Detroit.*

The displays will be dividea into two classes---operating and still---and one cup will be awarded for the best exhibit in each class.

The method of making these awards has not been decided, but will be left entirely with the executive committee and board of trustees of the Foundry and Manufacturers' Supply Association. The committee on awards can be chosen from the membership of this society, or it can be made up of foundrymen in attendance at the convention.

The cups will become the property of the exhibitors to whom they are awarded.

Each year we will present two similar prizes, to be designated as THE FOUNDRY CUPS, to be awarded as outlined.

The cups, which will be of original design, are now being made by well-known eastern silversmiths, and will be illustrated in an early issue of THE FOUNDRY.

At Detroit the cups will be displayed in THE FOUNDRY booth throughout the week of the exhibition.

A Gold Medal to be Awarded Annually for the Most Notable Achievement in Foundry Practice

To stimulate further interest in the advancement of foundry practice, John A. Penton of Cleveland, will donate a gold medal, each year, for the most notable achievement in the art of founding during the twelve months preceding the making of the award.

Individuals only can become recipients of this gold medal, and the competition for this honor is open to the foundrymen of the world.

It will be granted for distinguished research, invention, new equipment and appliances, improved tools, methods involving economies in existing practice, etc., provided they pertain to some branch of foundry work--iron, brass, or steel.

The conferring of this honor will be left with the American Foundrymen's Association, and it has been suggested that the first commission consist of past presidents of this society, with J. S. Seaman, of Pittsburg, the oldest living executive, as chairman.

This commission would be constituted as follows: J. S. Seaman, W. A. Jones, Arthur W. Walker, C. J. Wolfe, Thos. D. West, W. H. McFadden, Stanley G. Flagg, Jr., and L. L. Anthes.

Provided the organization of the commission can be effected and conditions of the award decided, the first medal will be awarded at the Detroit convention of the American Foundrymen's Association, to be held June 7, 8 and 9.

To perpetuate the award, the donor will make suitable arrangements with the commission to insure the bestowal of this honor each year.

are cut into the block *E*, Fig. 21, which is made separate from, but is bolted to the fixed portion *E*, Fig. 20, so that it may be easily renewed. This block *E*, Fig. 21, will require renewal after about 4,000 castings, and is the only part requiring renewal if ordinary care is used in handling the mold.

The movable portion *K*, Fig. 20, is mounted on rollers *B*, which are carried on adjustable track *L*, and can be raised or lowered by the adjusting screws *M*. When weights of less than the high limit are required, the track *L* is raised, carrying the portion *K* with its set of cores *F* to such a position that the distance between the lower cores and the upper cores is such as to make the weight required. It will be noted that raising section *K* does not, in any way, affect the relations existing between the various parts, except to alter the length between the upper and lower cores, and hence the length of the resulting castings.

In operation the movable portion is moved to place against the fixed portion *E*, Fig. 20, and the lower and upper cores are advanced by levers *F*. The pins *N* are inserted through the upper cores to form the eye for hanging, and molten iron is poured into the gates filling both cavities. The pins *N* are immediately withdrawn by hand, the upper and lower cores by the respective levers *F* and *F*, and the mold is opened by levers *D*, leaving the casting ready to be lifted out. Setting the cores, pouring, drawing the cores, opening the mold and removing the castings can be accomplished in one minute, and two laborers, in addition to the one who pours the metal, produce two weight castings in this period. One mold cannot be poured at such frequent intervals, so that six molds are used by one pair of operators, which allows them to make two castings per minute, pouring each mold at intervals of six minutes. In his investigation of the permanent mold problem, Edgar Allen Custer has been ably assisted by Robert A. Pitman, who has designed all of the permanent molds.

GRAPHITE BLOCKS FOR CUPOLAS

By EDGAR A. CUSTER, JR.

GRAPHITE blocks, in the breast of the cupola, were first used in the foundry of the Tacony Iron Co., Tacony, Pa., following a series of mishaps and troubles with the ordinary sand breast. Running, as we do, a continuous stream of metal for four or five hours each day and amounting to 30 to 40 tons for each tapping hole, we had trouble constantly obtaining a sand mixture able to withstand the hard usage of such a run, without variance in the size of the tapping hole. To overcome this difficulty a number of different blocks of graphite and other materials were tried, resulting in the selection of the one we are now using.

This block, furnished by the Ross-Tacony Crucible Co., Philadelphia, is composed of the ordinary crucible mixtures and is given the same treatment in making as are crucibles. In shape it is similar to a spool, being 3 inches in length and 2½ inches in diameter through the body. The flanges on either end add about ½ inch to the diameter. Through the center, as in the case of a spool, is a hole through which the metal flows, ranging in size according to the rate of melting of the cupola. One end of this hole is countersunk ½ inch to afford a grip for a clay putt in case it should be necessary to stop the stream of metal.

In ramming these blocks in the breast, a bar is inserted in the hole to afford a means of holding the block in the required position and to prevent the hole becoming filled with sand. The bottom of the breast cavity is then covered with loose sand and the block is bedded-in until the hole is the required distance above or below—as the case may be—the sand bed of the cupola. Sand is then packed tightly on all sides of the block and rammed hard. The sand is then cut away until the face of the block is exposed, and the bar removed.

When the cupola is ready for the blast, the hole is filled with burnt or sharp sand to prevent the first iron melted running in and freezing. After the blast has been on long enough to insure the metal being above the tapping hole, the cupola is tapped out.

After several trial heats we soon found a size for the hole which carried away the iron at exactly the same rate at which it was melted, thus insuring a continuous run for the whole day. We use these blocks in sizes varying from ⅛ inch and regulate the cupola, by means of the air blast, to suit the size of the block.

At the end of a day's run a bar is inserted in the hole and the bottom dropped. This bar is allowed to remain for two or three minutes and is then removed, leaving the hole clear and free of iron or slag. When the cupola is cleaned and chipped out the block is removed and the adhering sand knocked off. If in good enough condition, the same block is used the next day, and so on as many times as the block will stand.

The number of times one of these blocks can be used varies according to the amount of iron run through and the duration of the run. We found that one block was able to stand four, and sometimes five, heats, each of 25 to 30 tons and lasting four hours. Later on, when using a larger cupola we found that one block could stand two, and sometimes three heats of 35 tons poured off in about 3½ hours. In the latter part of last year we used these blocks in our largest cupola, melting 20 tons per hour, and in this case we found that we were seldom able to use the same block more than once, but this can be accounted for by the fact that in making the hole large enough to carry away the iron at the required rate, there was less than ⅝ inch of block left around it. The chief difficulty with these blocks, and that which causes most of them to be thrown away is, that after an unusually severe run or after two or more light runs, they become brittle and, while still able to withstand the effects of the iron, they are cracked or broken in removing.

Under normal charging, blast and weather conditions we can, with the use of these blocks, tap out at the beginning of a day's run and leave the cupola absolutely alone until the end of the run, and have a uniform stream of metal all the time.

When we have had occasion to stop the stream there seemed to be less tendency for the iron to freeze in these blocks than in the ordinary sand breast. Small particles of coke do not clog or trap in the holes, and "twisters," or spiral streams of metal, caused by pieces of coke being carried through, which often do so much damage to a sand breast, have no effect at all on a graphite block.

The feature which makes these blocks most valuable to us is the assurance they carry with them, and whatever else may happen to the cupola, the days of breast troubles and irregular streams are past.

EUROPEAN MOLDING MACHINE PRACTICE

Discussion of the various types of molding machines in English, German and Italian foundries --- Sand preparing and conveying equipment

MOLDING machine practice in European foundries was recently discussed in an address delivered before the Birmingham, Eng., branch of the British Foundrymen's Association by H. S. Green, of the London Emery Works Co., London, Eng. Molding machine installations in many European foundries were illustrated with lantern slides. Mr. Green in his opening remarks referred to the rapid advance of the molding machine practice in Europe, and stated that as early as 1888, it was found that 43 molding machine operators in a stove foundry made the same quantity of molds in a given time, as 300 skilled hand molders. In 1904 this concern installed two molding machines of a more modern type, and with two men on each machine produce 45 complete stoves a week. Regarding the utility of molding machines, Mr. Green said, that not only are cleaner castings insured, but the saving of metal, owing to the greater uniformity of the castings, is no small item. He added that they were frequently installed and proved economical where one would hardly think the output justified their installation.

Hydraulic Power.

Hydraulic power was recommended for drawing deep patterns, as well as for patterns mounted on large machines. The patterns can be withdrawn from the mold either by lifting the patterns out of the sand, the flask remaining stationary, or by lowering the flask away from the pattern, the pattern plate remaining stationary. The first method is employed for very deep patterns and large flasks, and the second for shallower patterns. The pattern-drawing machine has several advantages, especially when the flasks are very deep, as it can be built considerably lower than the machines, which drop the flask away from the pattern.

Coremaking Machine.

A hydraulic, pattern-drawing molding machine with two rams on the side cylinders for lifting the pattern was shown operating on castings for dynamos etc. A hydraulic turn-over molding machine, as well as a coremaking machine, are shown in Fig. 6. The output of two men on these machines, including the making of the cores, is six journal boxes an hour, the flask being 24 x 16 inches. In Fig. 4 is shown a machine for mold-

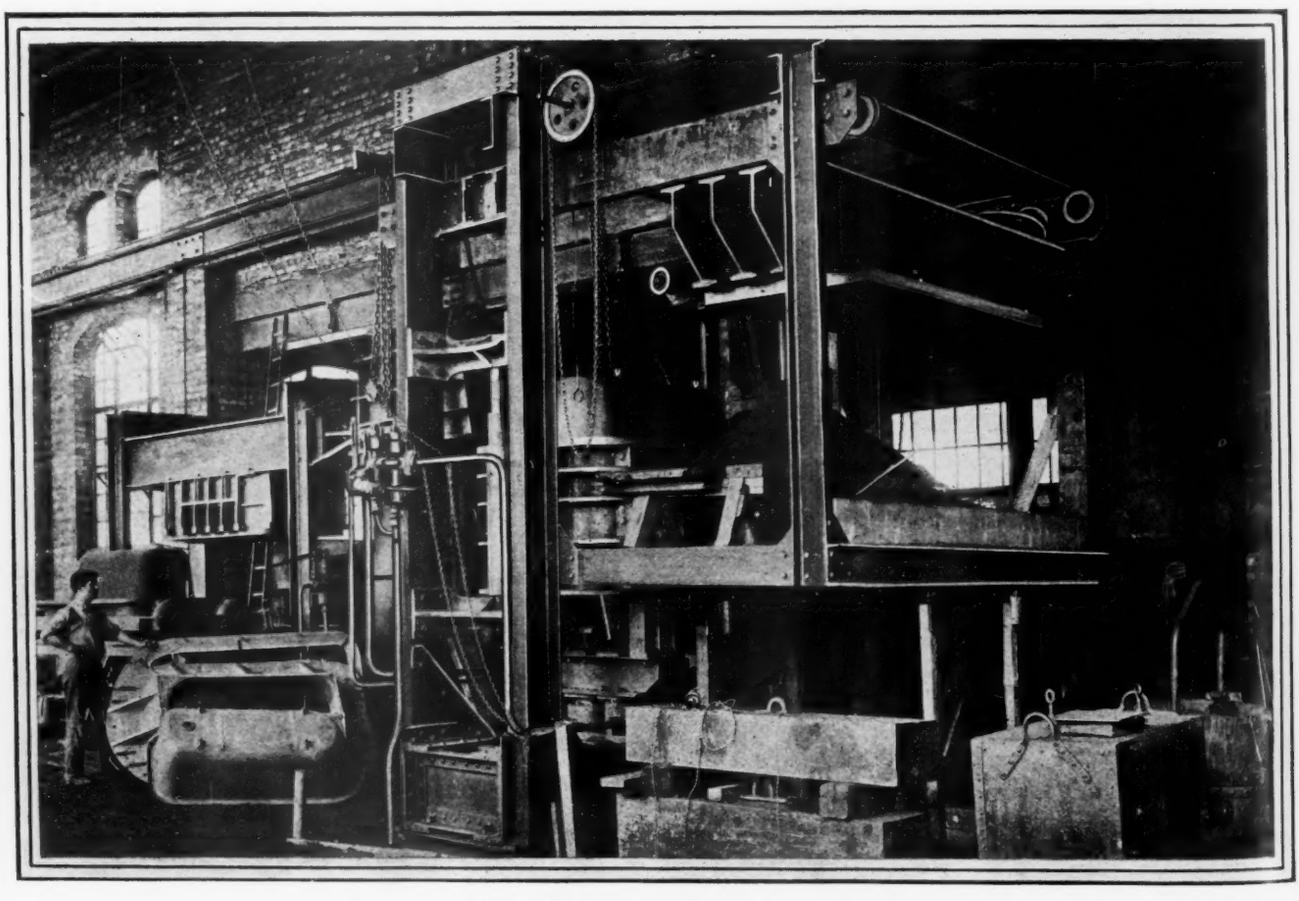


FIG. 1—BATH TUB MOLDING MACHINE

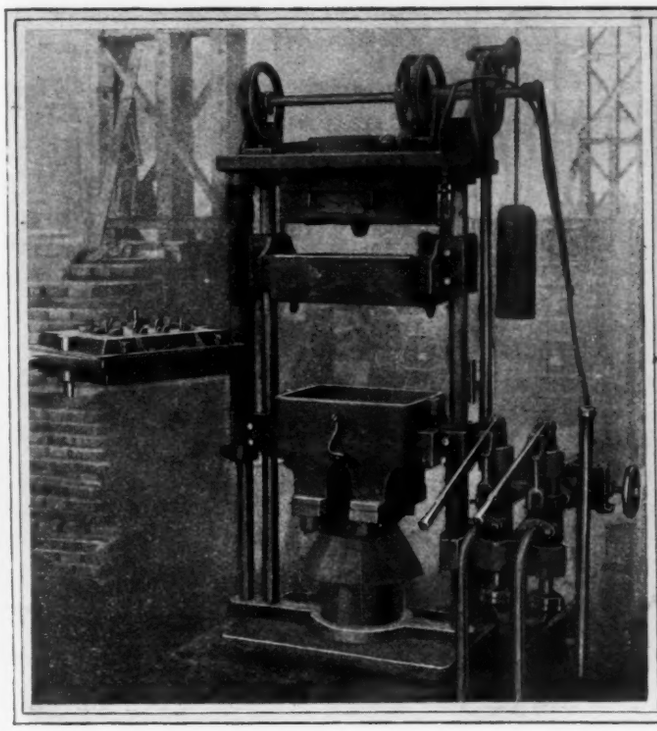


FIG. 2—MOLDING MACHINE ON WHICH NO FLASKS ARE USED WHEN RAMMING THE MOLD

FIG. 3—A VIEW OF A FLOOR OF MOLDS PUT UP BY ONE OPERATOR IN SIX HOURS ON THE MACHINE SHOWN IN FIG. 2

ing cases for motors. The flasks are 3 x 4 feet, and four men produce 12 molds per day. With a similar machine on which a pattern for a boiler section was mounted, four men molded 28 flasks, 5 x 3 feet and 8 inches deep, per day. A view of a machine was shown on which nearly all of the cast iron tunnel plates for the Paris underground railway were molded. The flasks were 6 feet 6 inches x 3 feet 3 inches, and four men produced 16 molds daily. For molding locomotive driving wheel centers the machine used was fitted not only with hydraulic power for ramming the molds and drawing the pattern, but also with an auxiliary arrangement for moving the bottom carriage on which the flasks rested. The flask used was 7 feet in diameter and the net weight of the complete equipment was 30 tons, the turn-over plate alone weighing three tons. The machine was 18 feet 6 inches high, 19 feet 2 inches long, and 13 feet wide. One of the greatest advantages of the use of this machine was the saving in cost of pattern repairs. The firm, which installed the machine, made 120 castings from a wooden pattern, which, when removed from this machine, was almost in as perfect condition as when it was mounted. When these sections were molded by hand, the pattern had to be repaired after the production of every two or three molds.

Bath Tub Molding Machines.

A bath tub molding machine was next shown, on which the core, as well as the cope and drag, are produced. This machine is shown in Fig. 1, one of the cores having just been completed. The tub castings have an over-all length of 6 feet and with the facilities offered by the continuous sand handling plant, the output on this machine, of three men and two boys, including the casting

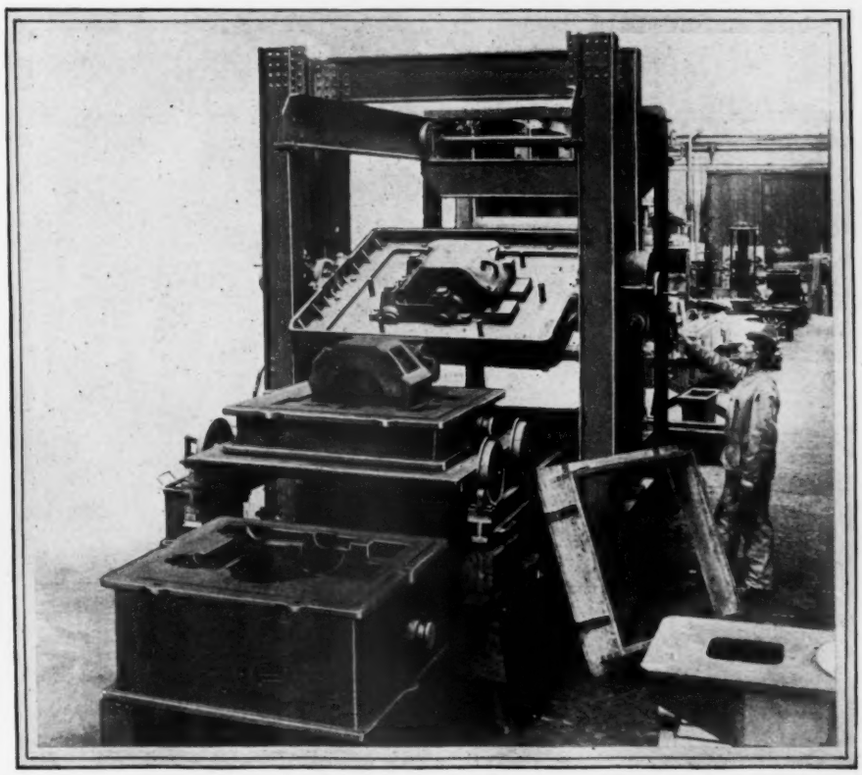


FIG. 4—LARGE MACHINE FOR MOLDING MOTOR CASES

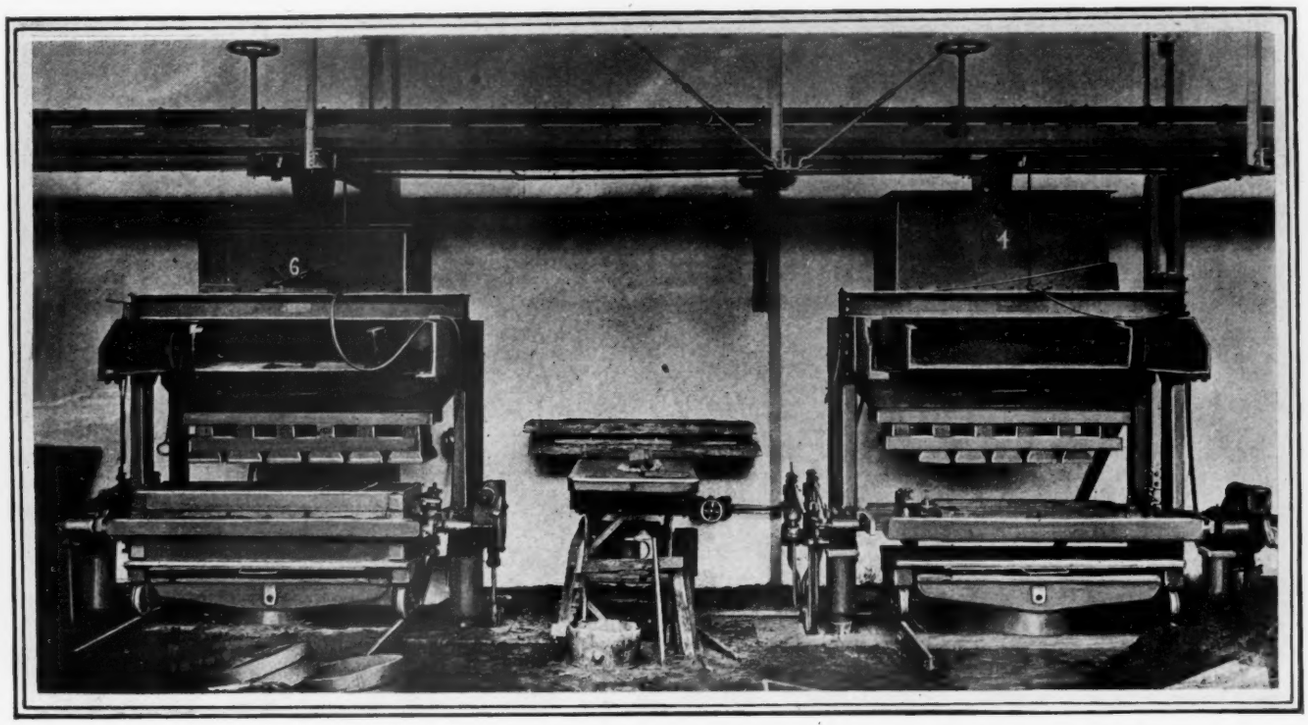


FIG. 5—TWO LARGE HYDRAULIC TURN-OVER MOLDING MACHINES EQUIPPED WITH SAND HOPPERS

and shaking-out of the flasks, is 18 tubs per day.

Electrically-Driven Molding Machine.

A portable molding machine, electrically-driven, shown in Fig. 9, was next illustrated. This machine was especially designed for the production of molds for radiator loops. The operation of the machine is practically automatic, and when the motor is set in motion the machine rams the mold, draws the pattern, and the motor is switched off automatically. The output of one of these machines, thus far, has been from 80 to 100 castings per day with three operators. Two men attend the machine, while the third closes the flasks and does the pouring. The loops are 40 inches long. What are termed as closed flasks are used on these machines, the bottoms being perforated for permitting the gases to escape. By the use of these flasks less sand is required, and they can be inclined when the metal is being poured without being clamped to the bottom boards on either side, and furthermore, they require no weighting.

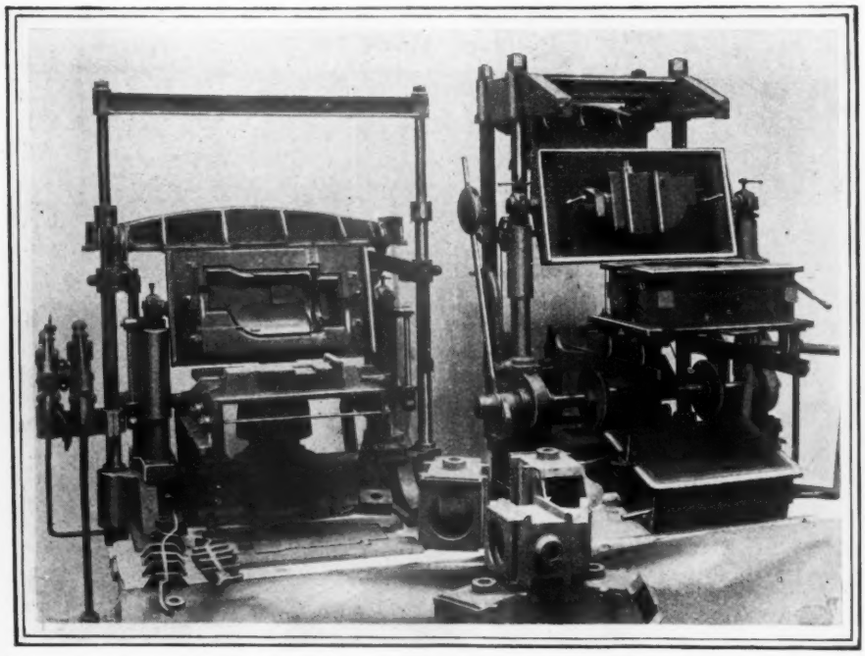


FIG. 6—HYDRAULIC TURN-OVER MOLDING MACHINE AND CORE MOLDING MACHINE

Flaskless Molding Machine.

Another type of molding machine on which no flasks are used, is shown in Fig. 2. Both cope and drag are made in one operation, and swinging aside the plate carrying cope and drag patterns permits of the closing of the mold on the machine. A view of a floor put up by one operator in six hours on a machine of this type, is shown in Fig. 3. Machines for molding hollow ware, Mr. Green said, have not been extensively introduced in Great Britain, but on the Continent a large number of these machines of various types are in use. Customarily three machines are operated simultaneously, the cope being made on one, the core and drag on another, and the mold assembled and closed on a third. Two large hydraulic turn-over molding machines provided with sand hoppers, which greatly facilitate the molding operation, are shown in Fig. 5.

Utility of Coremaking Machines.

Coremaking machines were next discussed by Mr. Green, and introducing the subject he stated that the production of machine-made cores is of the utmost interest to all foundrymen. Numerous machines were illustrated and described, and it was

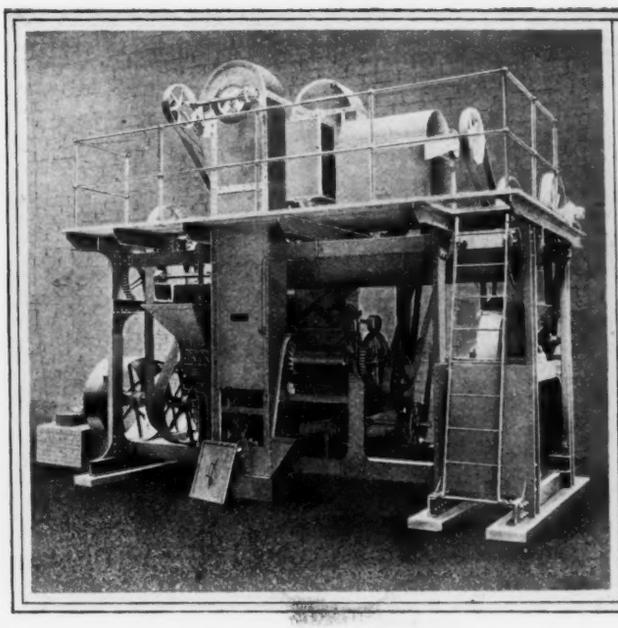


FIG. 7—SAND-PREPARING MACHINE

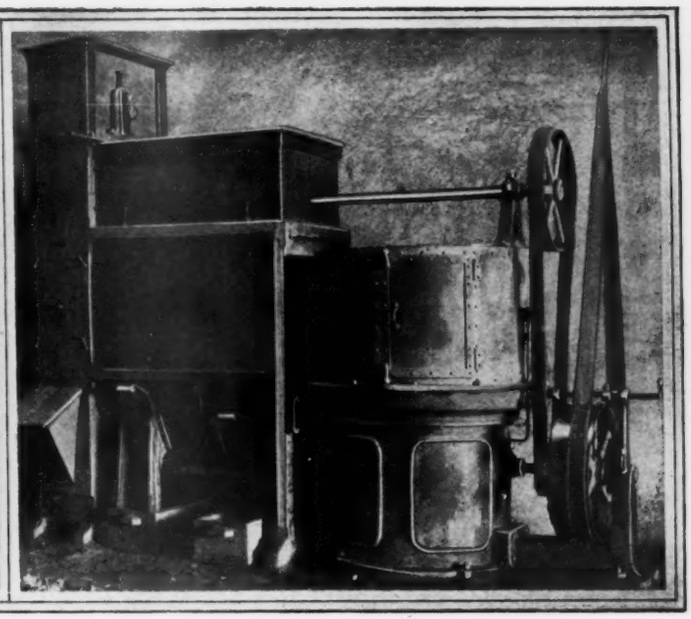


FIG. 8—SAND GRINDING MILL

stated that the core machine shown in Fig. 6 could produce almost any core that could be made in a two-part core box. Two half core plates are required, an intermediate filling frame and a board on which the cores are carried away. One-half of the core box is placed on the turn-over plate of the machine, while the other half is fitted to the ramming head. The intermediate plate, in many instances, is then placed on the lower core plate and is filled with sand. The intermediate plate is then removed, leaving the cores in the rough, ready for pressing. After being pressed the completed core rests on the lower core plate. The carrying-away board is then placed on the plate, turned over, and the cores are drawn away from underneath. The output of the machine is very large, while the cores produced are made in one piece, and are, therefore, more accurate than when they are pasted together. When making bibb cock cores on one of these machines, one man has produced 96 cores an hour. Two large core-making machines were illustrated, one for making cores for gate valves, the output of which with two operators, was 12 half cores per hour. The size of the core plates was 48 x 22 inches. A plunger core machine for making cylindrical cores was also described, as well as a machine of the same type for making cores up to a maximum diameter of 8 inches.

Sand-Preparing Plants.

The preparation of molding sand, Mr. Green said, had not received the attention from foundrymen that it deserves. He added that this was not merely true in the small foundries, but also in the larger ones, and the lack of attention to this detail is practically universal in Great Britain. In many parts of the British Isles the foundrymen are blessed with a better quality of molding sand than is possessed by Continental casting manufacturers, but he stated, that, nevertheless, the quality and appearance of the castings would be improved if more attention were devoted to the preparation of the molding sand. Owing to the introduction of power-ramming molding machines, a more open sand is required than for hand molding, and this porosity can only be obtained by machine preparation. The greatly improved results that have been obtained by preparing the molding sand thoroughly, has resulted in many foundries in erecting special buildings for this work. Furthermore, it was pointed out that it was not economical to permit machine operators or skilled molders to spend a considerable portion of their time in preparing and handling their own sand.

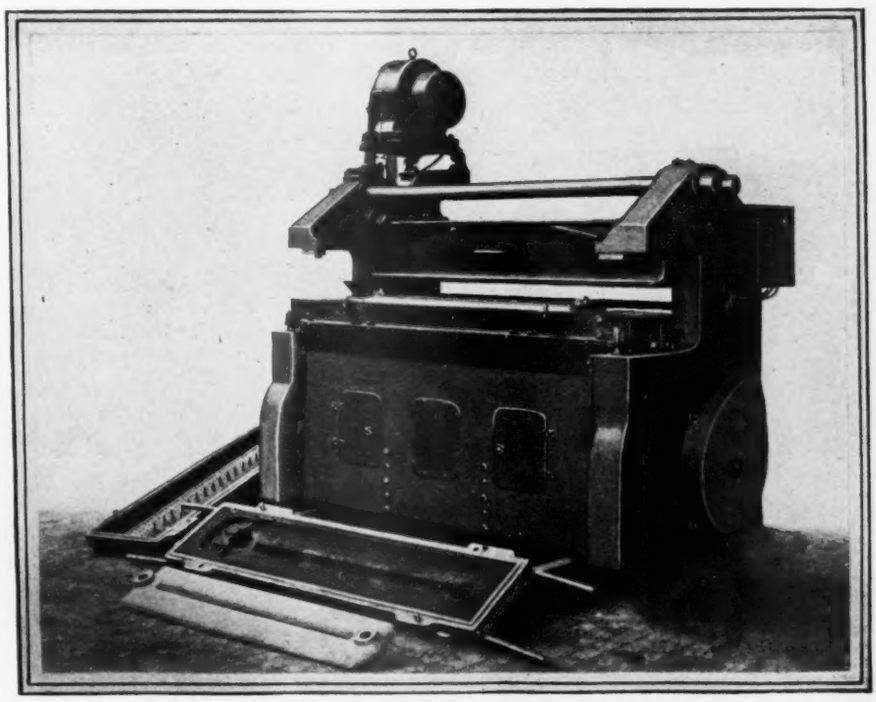


FIG. 9—ELECTRICALLY-DRIVEN MOLDING MACHINE ON WHICH THE PATTERN OF A RADIATOR LOOP IS MOUNTED

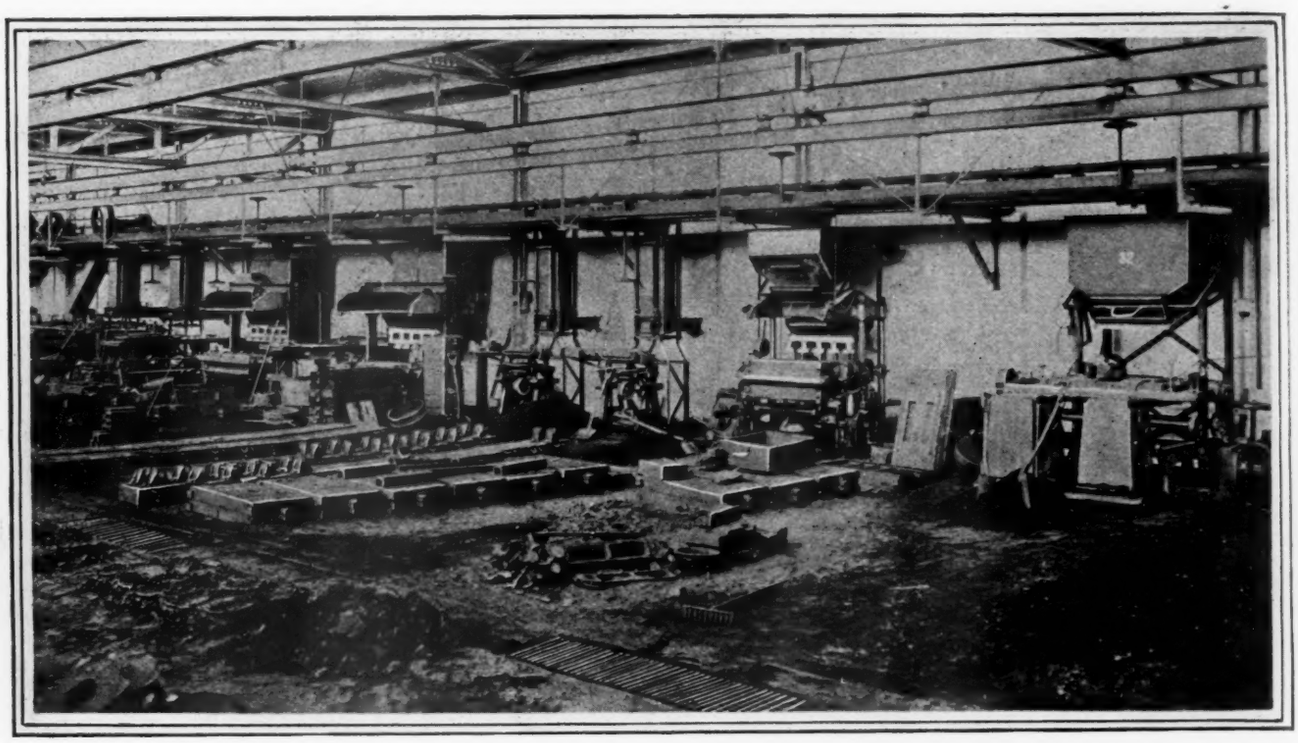


FIG. 10—SAND CONVEYING SYSTEM FOR LARGE HYDRAULIC MOLDING MACHINES IN THE JULIUS PINTSCH FOUNDRY, BERLIN, GERMANY

The sequence of operations required for the thorough preparation of the sand was described by Mr. Green as follows: The new, wet sand is delivered to the drying oven and is then passed over a sieve through which the fine particles fall onto the conveyors, while the coarse sand is delivered to the grinding mill. In the meantime the old sand is passed through crushing rollers to break up the lumps, and it is then passed through a magnetic separator which removes pieces of iron, gates, etc. The sand is next passed through a sieve, which retains any coarse lumps, stones, etc. The new sand, old sand and seacoal is then delivered to a mixing and tempering plant, and the entire batch is finally passed through a horizontal sand mixing machine.

In describing the machinery required for the preparation of molding sand, Mr. Green said that ap-

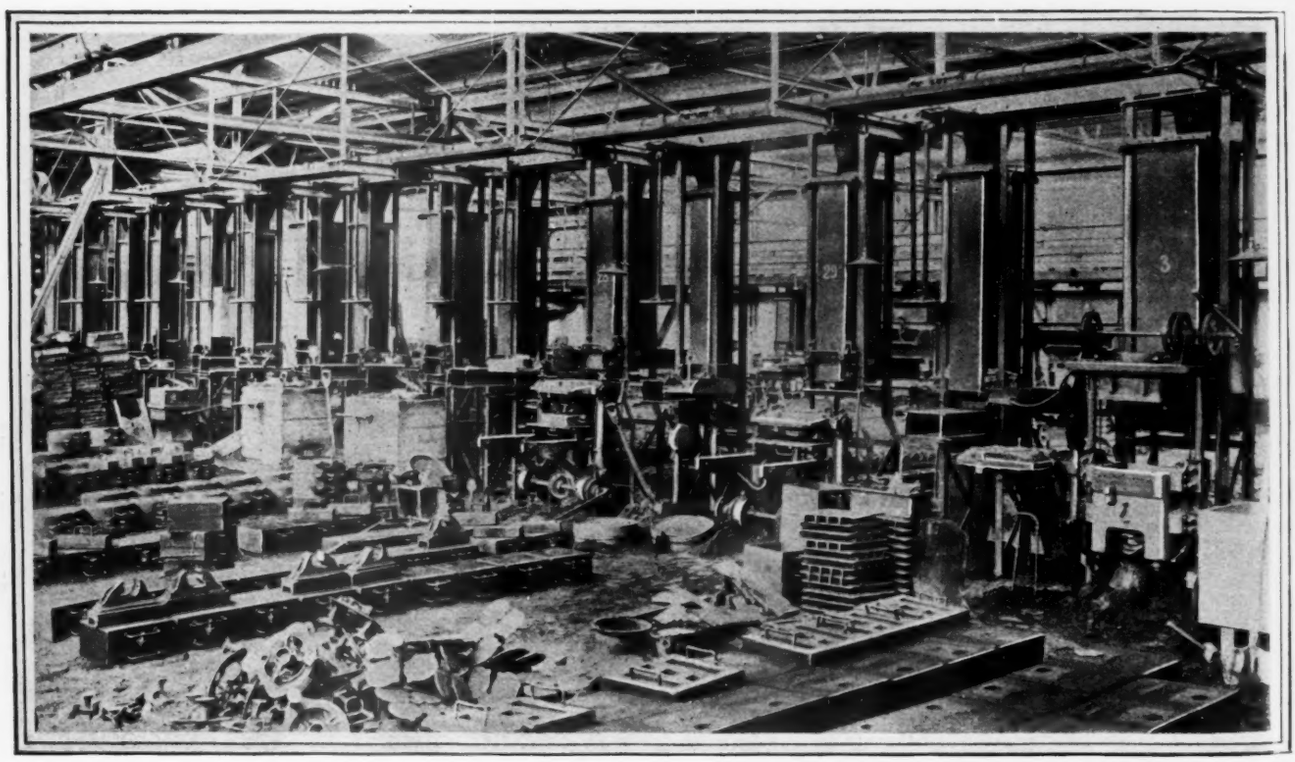


FIG. 11—SAND CONVEYING SYSTEM FOR SMALL MOLDING MACHINES IN THE JULIUS PINTSCH FOUNDRY, BERLIN, GERMANY

paratus must be provided for drying the sand, and in many foundries special drying ovens have been installed. After being dried the sand must be cleaned and ground, and an illustration of a complete sand handling plant, Fig. 7, was next given. In Fig. 8, is shown a grinding mill equipped with a screen and sand bin in which new sand is ground and prepared. The plant shown in Fig. 7 was described in detail in THE FOUNDRY, July, 1909.

Sand-Preparing and Conveying Plant in a German Foundry.

The sand-preparing and sand-handling equipment installed in the Julius Pintsch foundry, Berlin, Germany, shown in Figs. 10 and 11, was next described. This concern, Mr. Green stated, when making inquiry for this installation, asked for designs and prices on a sand-preparing plant for the production of light castings. The foundry is operated on the continuous system, and the sand-preparing plant is required to handle approximately 4,200 cubic feet of sand per day. The entire equipment was installed by the London Emery Works Co., and it was decided to erect the molding machines in two rows in the center, and one row on either side of the foundry. Between the rows of molding machines a grating was laid with the conveyors underneath, which carries back to the sand preparing department the used sand as it is shaken out of the flasks. The sand is carried to the molding machines by overhead, push plate conveyors, and above each machine a sand bin is placed in which a considerable quantity of sand can be stored. The sand-preparing department is in the basement underneath the foundry. The sand, as it is delivered from the conveyor underneath the floor, is carried to two machines, each fitted with crushing rollers, magnetic separators and sieves. After being sifted the sand is dropped into the mixing and tempering apparatus, into which new sand is also dropped from time to time. An elevator at the end of the mixing trough carries the sand to the foundry floor, where it is equally distributed into two conveyors, which carry it to horizontal sand mixers in which it obtains its final preparation before being delivered to the conveyors, which carry the sand to the molding machines. The boxes at the bottoms of the sand bins near each molding machine contain just the quantity of sand required for the flask on the machine, and the capacity of this box can be adjusted to serve flasks of varying sizes.

TEAM WORK MACHINE MOLDING

As applied to molds for car wheel centers, in the gray iron foundry of the Standard Steel Works, Burnham, Pa.

THAT the foundry offers a vast field for specializing is rapidly being recognized by progressive foundrymen, and that the molding machine is the medium by which higher efficiencies may be reached, is exemplified by the results that have been accomplished. It will be the purpose of this article to describe a class of work, which has been specialized, and also to give a few facts and figures showing the advantages derived from specializing, as compared with what was formerly accomplished by the old methods.

Selecting a machine possessing the necessary qualifications, is the first consideration. To obtain the desired results in this particular class of work, it is necessary for the machine to ram roll over a flask weighing 4,000 pounds, draw the pattern, and be manned by unskilled labor. It is also essential that means be provided for the rapid change of patterns so that the various sizes and types of patterns, (plate and arm) may be immediately set and properly aligned with reference to the required size of flask. The Tabor Manufacturing Co., Philadelphia, furnishes a machine for the purpose, known as the Tabor combination, 13-inch jarring and 48 x 12 x 20-inch hinged molding machine, which rams, rolls over the molds, and draws the pattern without the use of cranes or hoists. The pattern plate of the machine is provided with swivel cam clamps for holding the flask to the pattern plate while

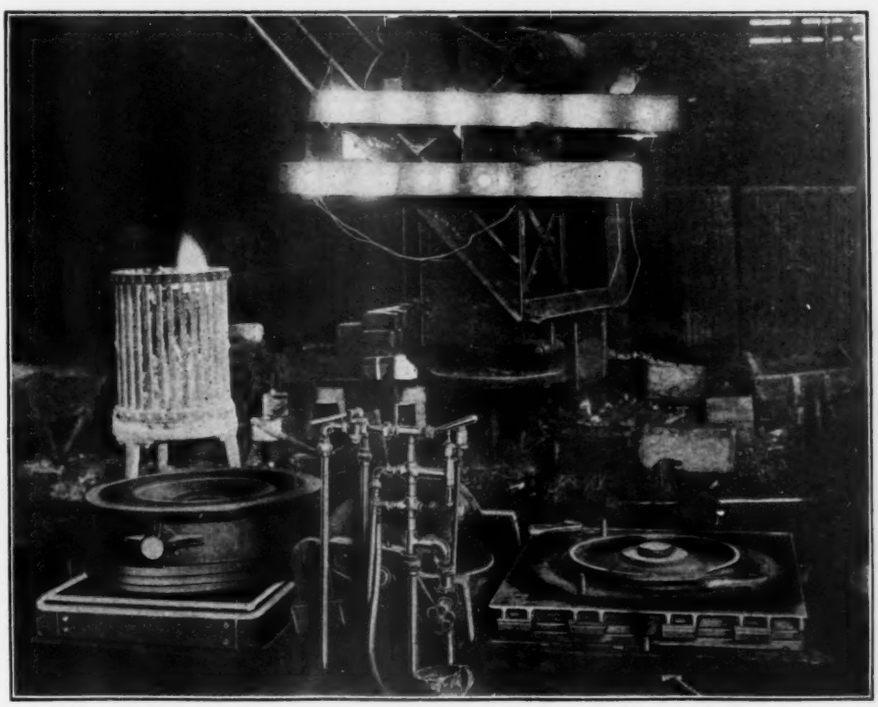


FIG. 1—MACHINE READY TO RECEIVE FLASK AT THE RIGHT, FINISHED FLASK AT THE LEFT

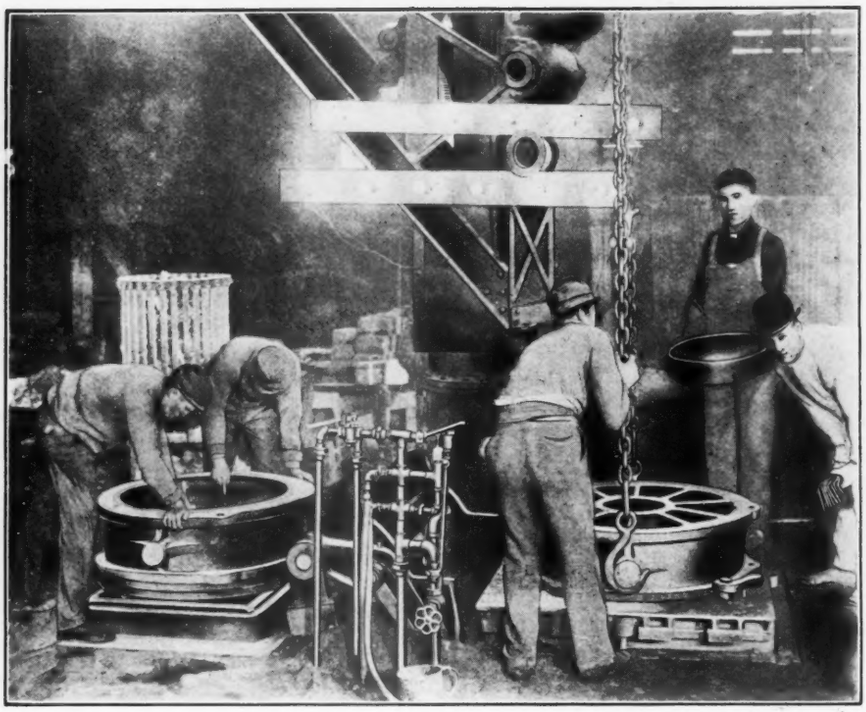


FIG. 2—LANDING COPE FLASK ON MACHINE AT THE RIGHT, FINISHING COPE MOLD AT THE LEFT

rolling over. The flask is located on the pattern plate by means of three flask pins, which project from the face of the pattern plate, and fit in holes drilled into the flanges of the flasks.

The flasks are of a heavy cast iron flanged type, the joint faces of which are machined. The cope side is fitted with heavy cast iron bars cast in, and the drag side is without bars. Cast iron bottom boards are used, and are bolted to the drag flask before it is rolled over by the machine. The patterns, (wood or metal) are attached to the pattern plate by means of screws.

The equipment for handling flasks and bottom boards consists of an eye-bolt, hooked on one end, the eye passing over the crane hook, and the hooked end into holes in the bottom board. The application of this hooked eye-bolt is illustrated in Fig. 4. Two straight eye-bolts about 18 inches long, are used to guide the bottom board to its position upon the flask, which is also illustrated in Fig. 4. An overhead traveling crane handles all flasks, bottom boards, removes the finished molds, and does the closing. A gang of night men shake out the molds, cut over, temper, and screen the sand, and pile the sand, bottom boards, and flask, convenient to the machine, and ready for use by the machine men.

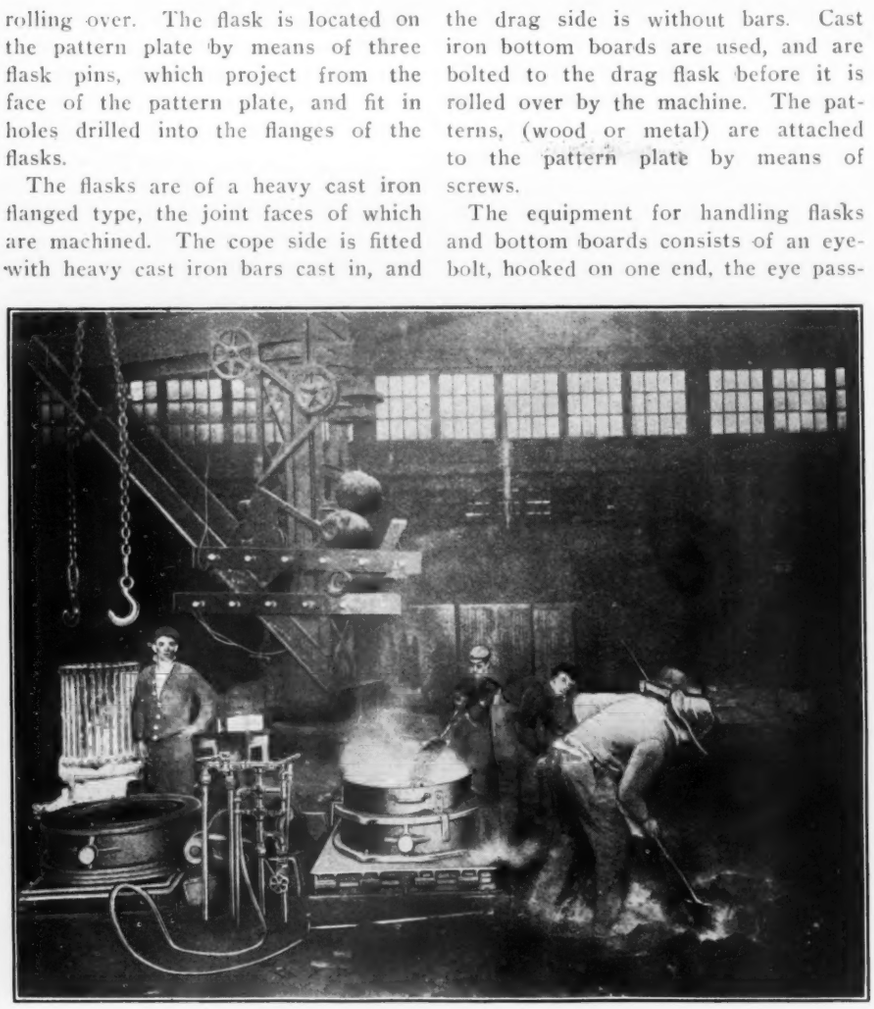


FIG. 3—SHOWING SAND FRAME SETTING ON FLASK, AND BEING FILLED WITH SAND, THE FOUR OPERATORS SHOVELING; CRANE HOOKS DROPPING TO RECEIVE THE FLASK AT THE LEFT

The Team.

The team of men connected with the operation of the machine consists of four operators, and two mold finishers. For convenience in reference, the team will be classified and numbered as follows:

No. 1—Operator, or man who controls the power operation.
Nos. 2, 3 and 4—Helpers.
Nos. 5 and 6—Mold finishers.

These men are not especially selected or trained for this work, as the whole team may be laid off, and a new one started, who within a day or two equal the production of the former team.

Operations.

After helper No. 3 has placed crane hooks on the flask trunnions, the flask is swung over the pattern plate on the machine, and is guided into place on the pins by operator No. 1 and helper No. 2. Immediately after the flask has landed, operator No. 1 gives the machine one jar, so as to settle the flask on the pattern plate, after which helpers Nos. 1 and 3 clamp the flask to the pattern plate. Helper No. 4 then riddles the facing sand over the pattern, after which he shovels in the facing sand as operator No. 1 distributes it over the pattern. Helper No. 3 sets gaggers, assisted by operator No. 1 and helper No. 4, as shown in Fig. 2. Helper No. 2 in the meantime is hooking the bottom board to the crane by means of the hooked eye-bolt. Helpers Nos. 3 and 4 place the sand frame on the flask, and all four men shovel in the molding sand, as shown in Fig. 3. Helper No. 2 levels the sand in the frame, while operator No. 1 operates the jarring machine, giving the cope 21 blows, and the drag 7 blows, depending upon which half is being jar-rammed. Helpers Nos. 2 and 4 remove the sand frame, and strike-off the mold, as the

crane brings up the bottom board, and while helper No. 3 has picked up two eye bars, one of which he inserts into a hole in the bottom board, the other he hands to helper No. 4, who in turn inserts it into an adjacent hole in the bottom board while it is being swung into place over the flask, as shown in Fig. 4; as one edge strikes the flask and tilts over, it is guided into place by helpers Nos. 3 and 4 inserting the eye bars into two holes in the flask flange, so that the holes in the bottom board drop in line with the holes in the flask. While this is taking place, operator No. 1 takes hold of the crane hook, and removes the eye hook, releasing the bottom board from the crane, after which he gives the machine one jar to settle the bottom board upon the flask.

In the meantime, helper No. 3 has picked up three bolts, nuts, washers, wrenches, and wedges, which he deposits on the center of the board and operator No. 1, and helpers Nos. 2 and 3 bolt the bottom board to the flask, and drive wooden wedges between the flask and bottom board, to prevent them closing under the weight of the cope flask. While this is being done, helper No. 4 goes for facing sand, bolts, or anything that may be needed.

Operator No. 1 takes his position at the operating stand, and rolls over the hinged frame, which carries the pattern plate and flask, as shown in Fig. 5, and while it is rolling over, with the blow valve, he blows off any loose sand which may have accumulated on the platen of the jarring machine.

Flask or Leveling Device.

As soon as the flask settles down upon the equalizing cradle or leveling device, the flask clamps are released by helpers Nos. 2 and 3. During the time the flask is seating itself on the equalizing cradle, and before the clamps are released, the cradle is vibrated, so that the flask will rest concentric with the line of draft after the clamps are released. After the clamps have been released, operator No. 1 starts the vibrator, and draws the pattern. The hinged frame carrying the pattern plate and pattern then rolls back to its original position on the jarring machine platen, as shown in Fig. 6. Operator No. 1 blows off any loose sand that may have dropped on the platen of the jarring machine as the pattern plate descends into place.

As soon as the pattern has been drawn from the mold, finisher No. 5 starts to finish the mold, while finisher No. 6 brings up and assists in setting the core and chaplet. While the hinge frame is rolling back, helper No. 2 has attached another empty flask to the crane, and as the flask is being conveyed to the machine, helper No. 3 blows off sand from, and cleans, the pattern and pattern plate. The flask is then placed in position on the pattern plate, and the team repeat the foregoing operations.

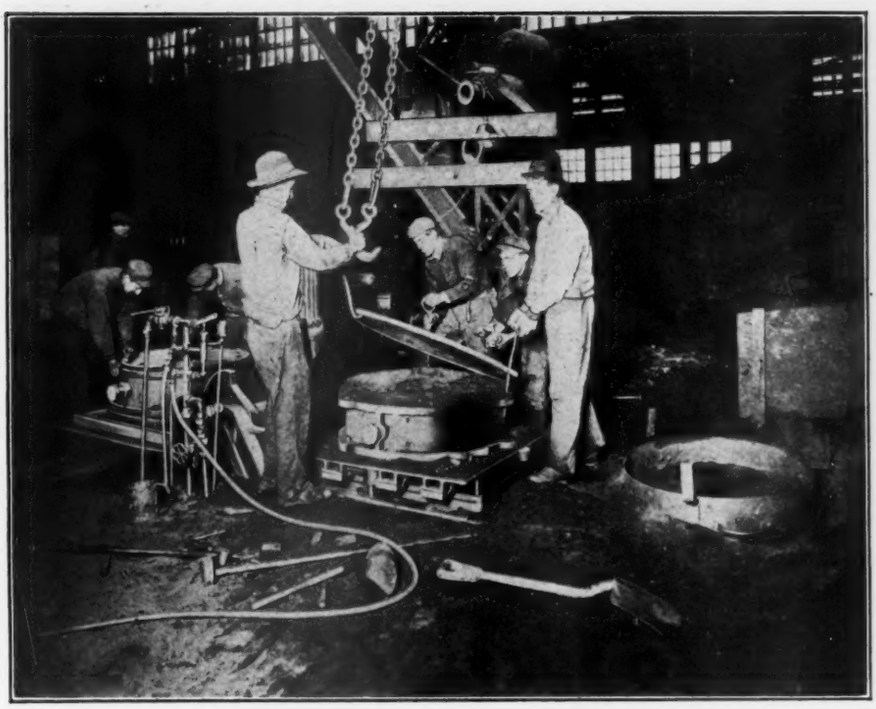


FIG. 4—METHOD OF LANDING BOTTOM BOARD ON RAMMED MOLD AT THE RIGHT; FINISHERS PUTTING LAST TOUCHES ON THE MOLD AT THE LEFT

After depositing the flask on the machine, the crane brings up another bottom board, and after setting the same in position on the flask, moves over to the completed mold resting on the equalizing cradle, removes and deposits it on the floor, ready to receive the cope half, should it prove to be the drag half. Finisher No. 6 closes the molds, and, after setting the runner boxes in place, returns in

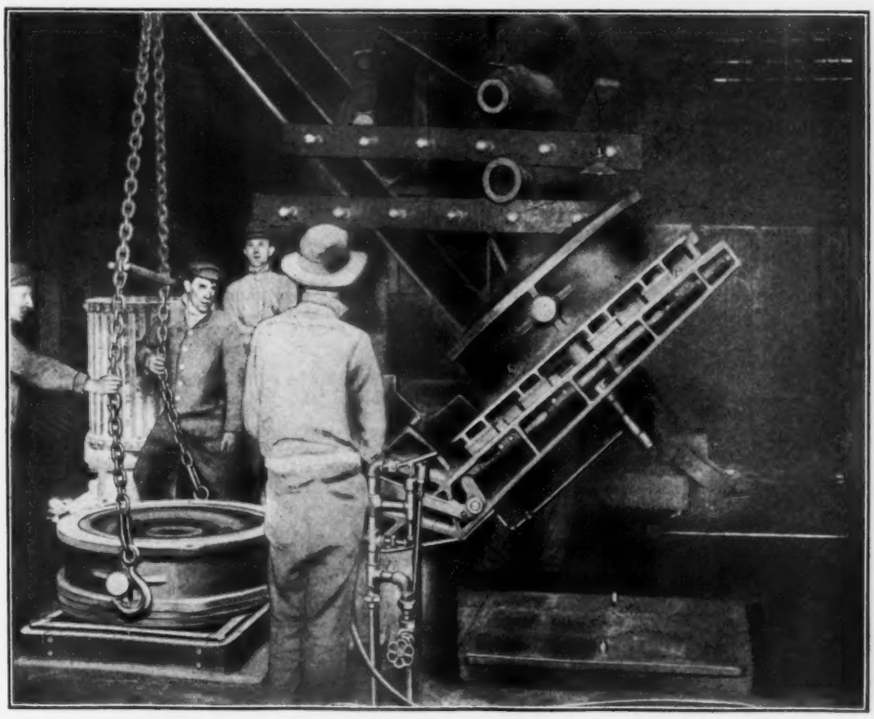


FIG. 5—MACHINE ROLLING-OVER RAMMED MOLD AS CRANE IS ABOUT TO REMOVE FINISHED MOLD

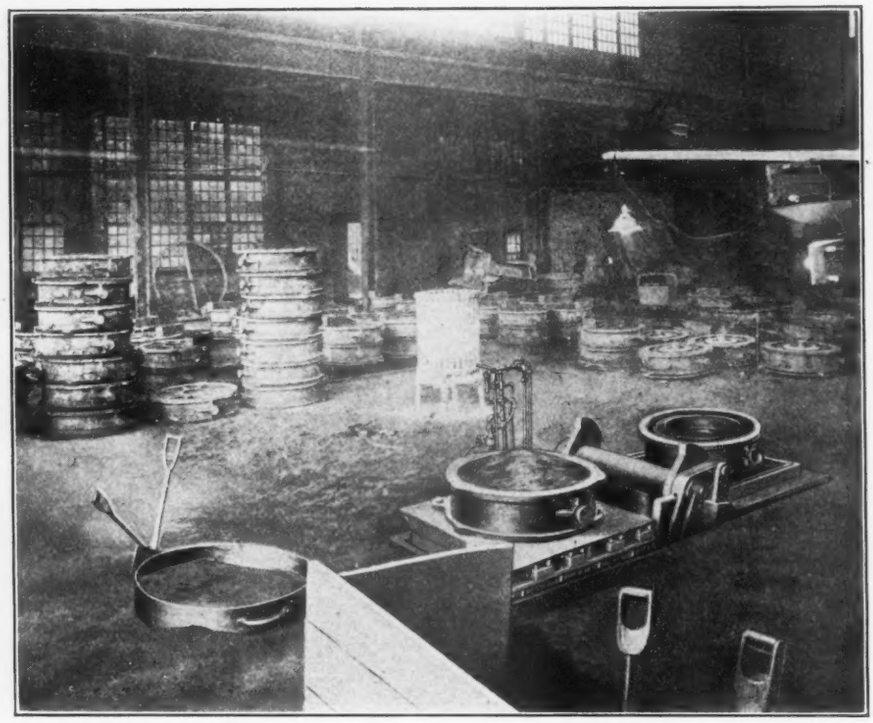


FIG. 6—GENERAL VIEW OF THE OPERATING FLOOR. AT THE RIGHT FRONT IS THE BIN CONTAINING FACING SAND. AT THE LEFT FRONT IS A PILE OF HEAP SAND. IN THE BACKGROUND ARE FINISHED MOLDS, WITH FOUR DRAG FLASKS WITH CORES AND CHAPLETS SET, READY TO RECEIVE THE COPE. IN THE LEFT BACKGROUND ARE SHOWN STACKS OF EMPTY FLASKS

time to assist No. 5 in setting the core in the next mold.

It may be of interest to know that the crane operator picks up an empty flask without assistance from the machine operators. This feat is made possible by the use of a spreader which locates the chains so that the hooks will hang apart the exact distance between the trunnions. This arrangement is shown to the upper left of Fig. 3.

The foregoing operations follow one another so rapidly, that very often the machine is rolling over the succeeding mold while the crane is swinging the preceding mold off of the equalizing cradle. This is shown in Fig 5. The illustrations accompanying this article were made from instantaneous flash-light photographs, and at no time during the photographing did the men cease work, or deviate from their regular routine.

Time for Making Mold.

The time required for a six-man team to perform this work varies from four to five minutes, depending upon delays caused by exchanging broken cores, fitting or withdrawing tight bolts, etc., or waiting for the crane. In the face of these delays, the team manages to put up, regularly, 50 copes and 50 drags for a day's work. This includes the setting of runner boxes, bolting up the flasks, etc. For the cope half of the mold the operations consume practically the same amount of time as for the drag half. The time for fitting the bottom board to the drag side about equals the time consumed for setting gaggers, sprue formers, and butt-ramming the top of the cope side. The latter is found necessary on account of the thickness of the cope bars, and the quality of the sand used.

Duties of Overhead Crane.

This machine is served by one overhead electric traveling crane. Its duties are as follows: Supplying the machine with the necessary flasks, gaggers, sand and bottom boards, removing the finished molds to the pouring floor, and closing the molds. At the latter end of the day, when the team is making and putting runner boxes on the last molds made, the crane assists in pouring. After the flasks have been shaken out, this crane removes them from the pouring floor, together with the bottom boards, and stacks each in a location convenient to the machine. This shows what can be accomplished by an overhead traveling crane, in a highly specialized foundry, with no dependence on transfer tables or other devices, which interfere with the freedom of the foundry floor.

The comparative costs for, and the time consumed, in making cast iron wheel centers by hand in accordance with old methods, and by machine, manned with a team of operators, is best shown in the accompanying table.

COMPARATIVE COST OF HAND AND MACHINE MOLDING.

Crane service assumed equal in both instances.

Average weight of finished castings..... 700 pounds
Average weight of drag (flask, sand and bottom board)..... 1,600 pounds
Average weight of cope (flask and sand)..... 1,600 pounds
Maximum consumption of air per half mold, = 160 cubic feet of free air or, 32 cubic feet per minute.
Maximum consumpton of air per complete mold, = 320 cubic feet of free air, or 32 cubic feet per minute.

BY HAND.		BY MACHINE.	
10 molders at $4 each per day	$40.00	2 molders at $4.50 each per day	$9.00
10 helpers at $1.60	16.00	4 helpers at $1.60 each per day	6.40
	$56.00		$15.40
20 men put up 48 complete molds (48 copes and 48 drags) per day of 8½ hours.		6 men put up 50 complete molds (50 copes and 50 drags) per day 8½ hours.	
Average loss in bad castings	14%	Average loss in bad castings	1%
Actual number first-class castings per day	41.28	Actual number first-class castings per day	49.5
Molding cost per good casting $56.00 / 41.28 =	$1.355	Molding cost per good casting $15.40 / 49.5 =	$0.311
Less cost by machine	0.441	Cost of air per casting	0.42
		Cost of maintenance, interest charges and depreciation (20 per cent per annum of total cost of machine) per casting	0.088
Saving	$0.914	Total cost per good casting	$0.441

Saving per casting	$ 0.91
Saving for 50 castings (one day's output)	45.70
Saving for 1 year (300 days)	13,710.00

The Westinghouse diary for 1910, published by the Westinghouse Electric & Mfg. Co., Pittsburg, as usual contains many valuable tables and much interesting information for the use of the electrical and mechanical engineer.

WORKS MANAGEMENT AND SHOP COSTS*

A comprehensive discussion of plant organization to obtain the highest efficiency at a minimum cost

By E. C. PECK

THE subject of factory management and shop costs is one of the most important factors in business today and is occupying the minds of a large number of managers and engineers. The United States probably owes its industrial supremacy to the ability of its captains of industry to systematically organize their business. It is true that this has been wonderfully aided by the genius and inventive ability of its engineers and mechanics, but the value of highly perfected machinery is materially reduced without organization.

Organization.

Organization is the foundation of economy in all business, and if of the right kind, it will always reduce the costs of manufacture. The most refined and elaborate system of costs is worthless without intelligent organization, in point of fact the cost system should be built up and maintained to suit each special organization. To get the best results, they must be in perfect harmony at all times, as each depends upon the other for results. An organized business without a cost system is, however, very much better off than one with a good cost system and no organization because the business could not use it. Let me make a comparison which will illustrate this. A certain manufacturing concern with which I was once connected was very well equipped with machinery and had well trained men. Its methods of manufacture were strictly up-to-date and the shop organization was good; in fact, orders went through the shop in quick time and with very little spoiled work. Each department was apparently turning out its share of the product as cheaply as possible. Thus, we may say, this factory (and by factory I mean departments outside of the office and shipping room) was organized to manufacture. However, it had no system of costs, whatever. The manager knew absolutely nothing about the costs of anything. Regular product was sold at established prices and special tools at prices which were guessed at. This business made money and grew steadily, but the manager only knew, that as a whole, his costs were all right because the money he had left each year after all expenses were paid was greater than the year before. Thus, we may say, with unchanged conditions, this business would be in no immediate danger of failure.

Failure of Elaborate Cost System.

Another establishment with which I was familiar introduced an elaborate cost system and, after it was installed, it could not be used. Neither the business nor factory was organized, and the vast array of figures and data collected meant very little and so was stored away for future use. The small army of clerks and the red tape necessary to make out an order and get it started so hampered the factory that deliveries were slow, the product fell off and everything in general was in discord most of the time. The cost of a particular tool could be figured out by an expert with some degree of accuracy, but when the manager was confronted with high costs he did not know what to do to correct the trouble. When it became evident that he should have started in to organize the manufacturing end first, then install a system of costs to suit it, the business was in such a bad way financially that he was forced to sell out.

Thus it is plain that the latter concern would have been much better off to have organized first, saving the money spent on the cost system until the time was ripe for it, getting increased product and earnings in place of losses.

Cost System an Extravagance.

I know there are some men at the head of large establishments who think that a cost system is a piece of extravagance and yet these same men have thoroughly systematized everything else pertaining to their business. So long as the business pays this policy seems to them to be all that is desired, but the time is surely coming when they will have to complete their organization by the addition of a cost system. The proposition to expend yearly $3,000 to $5,000 on a cost department is thought to be utterly ruinous, but it has been proven time and again that this amount is more than made up by avoiding the losses sustained on work, the cost of which was guessed too low because of the lack of data, which would have been at hand with an adequate cost system. In modern business it is competition that has forced the invention and perfection of highly specialized machinery, and it is also competition that will eventually force a cost system in addition to the organized factory.

Close Competition.

In these days of close competition prices for most manufactured articles are fixed within narrow limits, and a business, to survive and grow must, therefore, look to the cost of manufacture. In a new enterprise, the selling price may be fixed by the demand that can be created for the article by good advertising, but as soon as competition arises the selling price will be governed by the cost of manufacture, and the wise manager is he who knows to a fraction of a cent what it costs to make each article. If his competitors sell for lower prices he can be pretty sure that they have lower costs, are satisfied with less profit, or else they don't know what their cost is. Which of the three it is does not matter; he must meet the price, and if he maintains his profit at the lower selling price he must reduce costs of manufacture, and with a good system of costs he can analyze each successive step in manufacture and determine what change in method or equipment will bring about the desired results.

Tabulated History of Manufacture.

A cost system may be described as a tabulated history of each successive step in the manufacture of an article.

*Presented before the Metal Trades Superintendents' and Foremen's Club, Cleveland.

and an account of all the factors which enter into its production. From this it will be seen that, should competition or other conditions demand a reduction in the cost of manufacture, that manager who has a good organization and an adequate cost system will be in the best position to meet this demand, because he will have before him for analysis each single item, which goes to make up the cost. He will know where to curtail or where to combine operations necessary to the end in view. If in his estimation new equipment is necessary, he will have the figures at hand to show whether the amount of business will warrant the outlay. He will also know at all times just what part of his product is most profitable and can instruct the selling end to push that to the utmost. A little thought will show that in most cases this advantage alone would more than pay the entire expense of a cost department. First, that part of the business represented by the article to be pushed would be enlarged. Second, there would be increased profits due to larger sales. Third, a large number of parts to be manufactured would result in reduction of labor costs. Fourth, this would reduce overhead expense, and assuming that the less profitable part of the business was at a stand-still, its ratio to the whole would be less and might in time be abandoned altogether.

Highest Efficiency of Labor and Machinery.

Organization may be said to be the planning of the scheme of manufacture so as to get the highest efficiency of both labor and machinery. The first general organization of an ordinary size business is of course, the general officers of the company, and one of these or some one especially selected, is made general manager. This general manager becomes responsible to the company for the entire conduct of the business; it is therefore strictly up to him to so organize the factory as to obtain maximum results. The ideal general manager must be resourceful and a good judge of human nature; he should have a technical knowledge of the business and be at all times conversant with the commercial conditions; he must inaugurate and carry out the policies of the board of directors, in such a manner, that the manufacturing end is at all times in harmony with the selling and financial branch.

He must be able to surround himself with and keep a thoroughly competent corps of assistants, in fact his discernment in choosing men of ability for the heads of his organization is of vital importance. Many large companies acknowledge their success as being due in a large measure to this faculty of the general manager.

The Superintendent.

Next in importance to the manager is the superintendent, and he has, or should have, entire charge of the factory organization and is responsible to the manager for the entire conduct of the manufacturing end. A great deal, therefore, depends on the manager's selection of a man for this position. He should have a thorough technical knowledge of the business and be master of all its details. He also must have the faculty of choosing men of ability as heads of departments who can work harmoniously with himself and each other. He must be thoroughly conversant with all the prevailing conditions of manufacture, the capacity and earning power of each department. If a department is running behind or losing money he must be able to find the reason and correct it. It rests with him to keep the output of the factory in that relation to the sales that is determined upon by the manager, and at the lowest possible cost of production. This is the great "bug-bear" of all superintendents and causes more worry and loss of sleep than all the rest put together. This ability to manufacture at low costs is also his principal stock in trade, and proof positive of his ability to organize. He must be an expert on all the material which he uses.

Department Manager.

Next in importance to the superintendent is the department manager or foreman, and besides being an expert in his line, he must be able to handle men so as to get the most efficient results from both labor and machinery. He is directly responsible to the superintendent for everything that goes on in his department and everything that means the use of light, heat, power and equipment; the expense of running the department; the quantity and quality of the work; the economical and careful use of machinery and the discipline and harmonious association of the men under him. He should be thoroughly posted on all the work in his department and be able to inform the superintendent at all times as to the exact condition of the work in his department. The importance of his ability to retain efficient help is not less than that of the manager and superintendent. It is one of the important factors of the whole organization. One of his principal duties is to plan and supervise the methods of manufacture in detail, and to do this systematically and economically requires alertness, skill and thought. He should enforce discipline, be strict, but courteous at all times.

The first steps in an organization as just outlined are fundamental and if filled with men having the qualifications mentioned, the business is bound to succeed. Some enterprises are too small to support all the positions mentioned; they must of course combine some of them. Others are so extensive that there would be too much detail for any one person holding the positions mentioned to handle.

Simplicity of a Cost System.

I have already described a cost system as a tabulated history of each successive step in the manufacture of an article and an account of all the factors, which enter into its production. This may be simple or very complicated according to the size of the business and the amount of money allowed for the purpose. On general principles, it should be as simple as possible, and only require the tabulating of the information wanted. Few things are more disturbing than the operation of a too cumbersome cost system. They all require more or less red tape and the less there is to untangle, consistent with the object sought, the better. The cost to manufacture any article is the cost of material plus the cost to produce it under certain conditions.

Overhead Expense.

The cost of material is very easily obtained compared with that of production, especially in a large enterprise, because the overhead expense is a factor in the production and becomes a complicated item as the business increases. The overhead expense is made up of all those expenses necessary to conduct the business, outside of raw material and direct wages paid to manufacture the article. It includes the salaries of the officers, superintendent, foremen, inspectors, sweepers, watchman, etc., and the upkeep of all the machine tools, jigs and fixtures as well as the cost of the supplies. To illustrate this so that it becomes plain, let us suppose you were to start to work for yourself without capital or tools

or a shop of any kind, then the cost of the simplest work would be the material plus labor. If you required tools or implements, there would be an investment, and the upkeep of the tools to take care of. If your business grew and you required land or buildings to carry it on, you would have the items of taxes and insurance or rent to contend with, and in most climates also heat and light. If you prospered still further, you would require power. We might go on following the growth of your business indefinitely until there were several different plants, requiring branch stores, agencies, etc. This would bring about a large expense all of which must be included in the final cost, if you are to know exactly at what price to sell your product to make money.

Cost of an Article.

We might then describe the cost of an article to be the cost of material, plus the cost of labor, plus the overhead charges. Most accountants classify under overhead expense —taxes, insurance, depreciation, light, heat, power, repairs and unproductive labor. Unproductive labor is that which is required to carry on the manufacture but which can not be charged to or pro-rated over the cost of the fixed charges or overnead expense. The most common way of apportioning this is to divide the total overhead charges in dollars by the dollars of productive labor. This gives the amount to be added to each dollar of productive labor to take care of its share of expense. Using this plan, it is now plain to be seen that if we have the history of each successive step in the manufacture of an article, we would have the data at hand to figure the cost of each operation, we would know how much the material cost and be able to classify what was productive and what was non-productive labor. We would have an account of all the additional expense required and so fix the overhead charges. With these items correctly recorded, we could, with a fair degree of accuracy, figure the cost of each article of manufacture. The plan just outlined is used extensively, and for industries using both day-work and piece-work, it is less expensive and less liable to error, as all labor has to be reduced to dollars and cents for the pay roll. Obviously, it seems just to apportion your overhead charges to dollars of productive labor, because it is dollars you pay out for labor and expense.

There is, however, another plan which is attracting considerable attention and is known as the productive-hour plan. In this system the overhead charges are divided by the total number of productive hours and the quotient represents the number of cents to be added to the regular cost per hour for each hour of labor performed. It makes no difference what the wages of the workman are, the addition of overhead by this system is the same for each man per hour. The exponents of the average productive-hour method assert that the percentage basis cannot be a fair one, especially if there is any variation in products. They cite such examples as this: Suppose that workman *A* receives 40 cents an hour and works a 10 hour day at a bench, while workman *B*, at 15 cents an hour, works his 10 hours on a machine consuming a large amount of power and representing a considerable investment. The percentage system would not distribute the overhead expense fairly, for 50 per cent added to *A*'s job would be $2, while to *B*'s would be added only 75 cents, though the machine work should certainly be given at least as large a share of the burden as the bench work. Under the average productive-hour system each man's job would have $2 added to its cost, at 20 cents an hour overhead, which, in this instance, would be a much fairer distribution of the burden. Again, two employes may be operating lathes, one a 10 cents per hour boy, and the other a journeyman at $3 a day. Under the percentage system at 50 per cent, the boy's work would have but 50 cents added to its cost, while the man's would have $1.50.

This productive hour plan becomes somewhat complicated in a large factory using both piece-work and day-work, as all piece-work would have to be paid for by the piece and then either reduced to hours at a certain rate per hour, or else take the actual number of hours consumed in doing the work. This leaves chances for error in computation. Either one of these plans will provide a safeguard against selling at too low a price. Whichever one is used, the overhead should be figured at regular intervals, as it will be found to fluctuate considerably.

Proper Division of Overhead Expense.

Now, if a certain overhead is found necessary to cover all expenses, and all work, regardless of facilities or other conditions, bears a like proportion of this overhead, we are confronted with a condition, which is not fair to a customer and which will not stand competition. To make this plain, let us assume we have a large manufacturing plant composed of a number of departments. One of these departments is equipped with the ordinary machinery bought in the open market so that any one could purchase this same equipment and be on an equal footing with us to turn out the product from these machines. Another department has machines that are bought in the open market, but on which we have put some improvements. Our foreman of this department has so trained his help and systematized his work that we can do twice as much per workman as any of our competitors. Another department has some highly perfected automatic machinery, the product of which has a labor cost of only one-fourth of that of any of our competitors. Assuming that by the percentage plan our overhead is 100 per cent, we are asked to quote on a piece of work, which will be done in the first named department. We find the cost of material $5 and the labor cost $10. To this labor cost we add 100 per cent for the overhead, making $20.00, and $5.00 profit, making the price $30.00 and submit our quotation. We are informed that a small shop has quoted a price of $24 and has secured the work. If we met this price we would lose $1.00 on the work. A little inquiry shows the reason for this, our competitor's business and expenses are small and his overhead is only 50 per cent. This makes his net cost $20, leaving him a profit of $4. We would therefore be charging a customer too much for work done in this department.

Departmental Distribution of Overhead Expense.

Again, suppose this work was done in the third department, and use the same figures. Here our labor cost compared with any of our competitors is only 1 to 4 and our competitor would then start with $40 labor cost, and adding 50 per cent overhead, his net cost would be $65 or more than twice as much as our price. It would be quite evident that we would get the order for this work and the customer a very low price. A nice way to equalize this and a perfectly safe one is to figure overhead by departments. This can be done by prorating the selling, administrative and general factory expense over each department according to productive la-

bor, charging each department with its supplies, power, light, heat, repairs, maintenance and depreciation. Pro-rate, taxes, insurance, repair and depreciation of buildings over each department in proportion of its area to the whole plant.

This method of distributing overhead by departments seems to me to be the nearest correct of all methods so far proposed for the ordinary size factory. It relieves some of the excessive burden in departments which have small earning power and transfers it to those which have a very large one, and this is as it should be. It makes each department similar to a small shop when comparing equipment, and enables quotations to be made which will bring in orders without sacrificing profit.

Effectiveness of Supervision.

There is, however, always one important difference between the small and large factory that places the large one at a disadvantage, and that is the effectiveness of supervision. A small business operated by the owner will get more for the money paid out for labor than a large one, because the large one has to depend on men to supervise departments who rarely have the intense interest in the business that he has. This is especially noticeable where the different pieces of work are small in quantity. The large factory makes its showing on quantity and requires a large volume of business to be profitable.

What wonderful money-making institutions some of our large industries would be if the entire organization would enter into the work with the same spirit as the owner did when he was building up the business? Every superintendent and foreman ought to do it—the company's interest should be his, and they are if he is a far-sighted, thinking man. Your worth is judged by your ability. Your achievements are often discounted by the small things left undone. An accumulation of these result in losses, which detract considerably from your ability and value as an executive. Always remember you are on board this business ship to do your part toward bringing it to port on schedule time, without mishap and at a reasonable cost. Do your utmost to push the ship along, don't let it tow you into port.

Don't expect smooth seas all the time if you ever expect to be captain. Don't think your ship is the rottenest old tub afloat; that beautiful one on the horizon may be only a mirage. If you can't work with your captain and your mates in all kinds of weather, get off the ship. Remember that mere talk won't bring a ship through a storm.

Some one has aptly said "Eternal vigilance is the price of liberty." Let us change this slightly and use it for a motto:

> "Eternal vigilance and hard work is the price of success."

ESTIMATING FORM FOR JOBBING FOUNDRIES.

By H. Cole Estep

The first question which the customers of a jobbing foundry ask, when bringing a piece of work to the shop, is almost invariably, "How much will it cost?" With no accurate cost data at hand and no means of estimating the cost, the foundryman is not infrequently compelled to give evasive answers and to defer accurate pricing until after the work has gone through the shop. Next to well and promptly executed work, however, nothing so pleases the average customer as to be told the exact price of a job *before the work is done*. It is in this connection that the need is often felt for a simple estimating form, with the aid of which the shop cost of a job can be readily computed, and with this as a basis, the work can be priced with fair accuracy.

To meet this need the accompanying estimating form has been devised by D. F. DuFour, foreman of a large foundry near San Francisco. At the head of the form, it will be noted, is space for the date, class of work, a brief description of the work, the job order number and the customer's name. Next follows a form for estimating the cost of metal, columns being provided for the drawing numbers, pattern numbers, estimated weight, number of castings required, total weight of metal (20 per cent added to total weight to compensate for loss and weight of sprues), cost of metal per pound (determined from monthly bills of material), and total cost of metal in job.

Next follows a bill of material, with spaces for drawing numbers, pattern numbers and quantity and cost of core arbors, gratings, rods, bolts, plates, brick, coke, miscellaneous materials and the total cost of material. Both the quantity and cost of each item are briefly noted in the bill. Below the bill of material is space for the labor cost, this being sub-divided to show molders', helpers' and laborers' estimated hours and wages. Finally, there is provision for setting down the total cost, cost per ton and per pound, and also under "pro-rate" the amount to be added for fixed expense and profits. The estimate is signed by the foreman, assuming in this case that the foreman does the computing. The forms are printed on white, smooth paper, 5½ by 10 inches in size, ruled in black, and made up in blocks of 100.

These forms have been found very handy. In a comparatively small shop and with small jobs, which are the only kind for which the estimating form is used, it has been found sufficiently accurate for the purpose to arrive at the price of the work by adding to the labor and material cost, as shown in the estimate, definite percentages to cover fixed charges and profits. Fixed expenses, in this case, being figured as a percentage of the total labor and material costs for any one month, while profits are determined by individual circumstances and competitive conditions.

ESTIMATING FORM

Date:

Class of Work:

Description:

For: J.O.No.

Drawing No.	Pattern No.	Est'd Weight	No. Required	Total Weight	20% Added	Cost of Metal per lb.	Total Cost of Metal			Total
1	267	500	2	1000	1200	3	36.00			
2	269	350	3	950	1080	3	32.40			
								68.40		68.40

Bill of Material

Drawing No.	Pattern No.	Core Arbors	Grating	Rods	Bolts	Plates	Bricks	Coke	Misc.	Total

Cost of Labor

Drawing No.	Pattern No.	Molder's Hrs Rate	Total	Core Maker's Hrs Rate	Total	Helpers Hrs Rate	Total	Common Laborers Hrs Rate	Total

Total Sum:

Cost Per Ton:

" " Lb.:

Prorate:

Foreman:

The Foundry

ESTIMATE MEMORANDUM SHEET

The December number of the *Obermayer Bulletin*, published by the S. Obermayer Co., Cincinnati, contains the second of a series of articles by R. H. McDowell, entitled "Foundry Troubles—Their Remedy." In this number cupola operation is discussed and many valuable suggestions are made. C. R. McGahey takes up molding machines in a brief article, and the miscellany in this issue is interesting and well-selected.

THE OPERATION OF A SMALL CUPOLA.

At a meeting of the Pacific Northwest Foremen's Association, recently held in Seattle, H. W. Sumner, president of the Raineer Foundry Co., Seattle, read a paper describing some interesting features of the operation of a small cupola. The cupola referred to by Mr. Sumner was a home-made affair, 24 inches in diameter inside the brickwork. Using methods described in the paper, 9,000 pounds of castings have been poured in a single heat with this small furnace.

The cupola is simply a boiler plate cylinder, 28½ inches in inside diameter, lined with fire brick 4¼ inches thick. The bottom is made of plates, provided with suitable doors for dropping the charge. The lower line of the tuyeres is 13 inches above the sand bed, which is about 3 inches thick. The hearth has a capacity of 550 pounds of melted iron. The lower line of the charging door is 10 feet above the sand bottom.

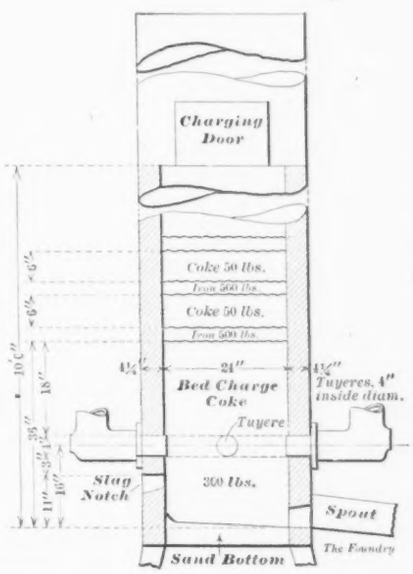
There is no wind box, the blast being led to each tuyere from the bustle pipe by means of a leg provided with a peep hole, similar to blast furnace construction. The tuyeres, four in number, set 90 degrees apart, are simple, cylindrical pipes, 4 inches in inside diameter. There is no attempt to make the tuyeres either nozzle-shaped or trumpet-mouthed.

In the average furnace the slag hole is placed 2 inches below the lower tuyere line; in this cupola the distance has been increased to 3 inches. It was found that with the slag notch only 2 inches away from the tuyeres, the effect of the cold blast was to freeze up the slag hole, thus interfering greatly with the working of the cupola over any extended period of time. An iron plate above the slag hole protects the brick work from injury when tapping out slag.

The lining consists of a single row of refractory firebricks, shaped to fit the cupola, the thickness of the brickwork being 4¼ inches. In this 24-inch cupola the lining melts 90 tons of metal before any extensive repairs are required.

The accompanying illustration shows the method of charging the cupola. The bed charge of coke, 300 pounds, is carried to a point 18 inches above the upper tuyere line. Charges of iron and coke in rounds of 500 and 50 pounds, respectively, follow the bed charge of coke in successive order. The 50-pound coke charge is 6 inches thick. The iron charges vary in nature. Some mixtures consist of half and half No. 1 English pig (Cleveland or Jarrow) and No. 1 foundry scrap. Varying amounts of steel scrap, which can be purchased as low as $6 a ton in Seattle, are also used. A popular mixture is as follows: No. 1 English pig iron, 60 per cent and No. 1 lumpy steel scrap, 40 per cent. For thin castings, ½-inch in thickness, only 20 per cent steel is used. No rusty steel is charged and lumpy steel is preferred to thin pieces. Ten pounds of limestone to form slag are charged with every round and also eight pounds of 80 per cent ferro-manganese. Fifteen pounds of limestone are charged with the first round in order to insure a liquid slag throughout the 9,000-pound heat.

Wilkeson foundry coke is used. At



SECTION OF A 24-INCH CUPOLA SHOWING TUYERE ARRANGEMENT, SLAG NOTCH LOCATION, METHOD OF CHARGING, ETC.

the present time a representative analysis of this coke is as follows: Moisture, 0.59 per cent; volatile hydrocarbons, 1.52 per cent; fixed carbon, 81.59 per cent; ash, 16.30 per cent; sulphur, 0.60 per cent.

LIGHTING CUPOLAS WITH OIL BURNERS.

BY W. J. KEEP

Question:—How long before the charging begins and before the iron comes down, should the coke bed of a cupola be lighted? What is your experience lighting a cupola with gas or materials other than wood?

Answer:—When very hot and uniform iron is required for light work, the fire should be lighted two hours before the iron comes down, and one hour before charging begins. It takes about one-half cord of wood for a cupola lined to 60 inches. One objection to wood, however, is its cost and the excessive smoke, especially if the foundry is located in a residence district. The reason for lighting the fire so early is to raise the temperature of the bottom of the cupola, as well as the walls, to a melting heat before the iron comes down. The chief cause of dull iron is due to the fact that the fire is not lighted early enough. The coke burned before the iron comes down can be saved later in the heat. We have tried lighting our cupola with charcoal, but the cost is too great. Artificial gas will ignite the coke, but this, likewise, is too expensive. Kerosene is satisfactory in every way, when burned in suitable burners.

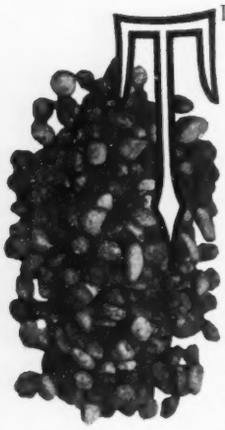
Crude oil sprayed in by compressed air has been found to be very satisfactory, and a description of the method pursued may be interesting. A hole, 6 inches wide, and 7 inches high, is cut in the side of the cupola shell and through the lining, so that the bottom of the opening shall be on a level with the sand bottom. A board is laid from the inside of the lining across the bottom to prevent drying out the bottom and blowing the sand away. Large pieces of coke are placed on the sand bottom, two layers high, to make one main channel 6 inches wide and 7 inches high, extending three-fourths across the cupola bottom with smaller channels branching out from either side. These channels are bridged over with pieces of coke and the bed is then added. The oil burner is then placed in the opening pointed a trifle upward, so that the flame will not strike the board with full force. The oil spray and the compressed air are regulated to give a blue flame, filling all of the passages in the coke, which can be lighted in about seven minutes. Compressed air is then blown in for a period of about 20 minutes. The wood necessary for lighting the cupola cannot possibly be furnished for less than 50 cents, whereas the crude oil costs about 5 cents. This shows a big difference in favor of the fuel oil burner, and in addition the smoke nuisance is abated.

The Kutztown Foundry & Machine Co., Philadelphia, Pa., is sending a handsome calendar to the trade, which contains an embossed print, entitled "Drifting."

ENAMELED CAST IRON SANITARY WARE-IX

The sand blast equipment of the bath tub foundry---The use of grinders with a detailed description of the bath tub rim grinding machine

By DILLEN UNDERHILL



THE cleaning of castings for enameled ware is accomplished largely by the use of the sand blast. A wire brush is used to remove the thick coating inside and outside the tubs, after the castings are taken to the sand blast room. The tumbling barrel is not used for several reasons. The tubs are too large and the lavatories and small-ware do not pack well. Furthermore, when cleaned this way, considerable dust still clings to the castings when they are taken out of the tumbler and the sand cannot be removed from the cavities. By the use of the sand blast a perfectly clean casting can be obtained and no dust, which is injurious to the enamel, is left on the metal. If any of the sand blast sand is left on the casting, it will melt and form a part of the glass, which is a constituent of the enamel. The most serious problem in sand-blasting is the removal of the dust. The air in the room where the sand-blasting takes place is saturated with a fine powder from the broken particles of sand, and if not properly taken care of will penetrate adjoining buildings, rendering them uncomfortable to work in.

Exhausting the Dust Into Water.

Naturally, one would think that exhausting into or under water would solve the problem. This, however, is not the case. When the dust is exhausted into tanks, it forms into little globules, and these rise to the surface, open up, and the dust nuisance is still the same as before. Of course, some dust settles to the bottom; but sufficient rises to the top to make the sysem ineffective. In one instance, the dust was exhausted into a river and it was believed that the volume of water would be large enough to moisten the particles, but this proved as unsatisfactory as the tank and was soon abandoned.

Dry Exhaust System.

Two general systems have been developed and have proved successful. The dry system of exhausting through cloth is being installed by a prominent manufacturer, in many enameled iron plants. Briefly, an exhaust fan carries the dust and air into an enlarged chamber where its velocity is spent in attaining a larger volume. The dust strikes the cloth, but does not pass through it, while the air seeps out with hardly any perceptible current. The sand drops down into a receptacle and is removed.

Steam Exhaust System.

The second system, while probably not quite as clean as the dry method, has the advantage of being inexpensive both in installation and maintenance, as it can be built by a carpenter and a plumber in a short time. It takes care of all the dust by exhausting steam into a large wooden chamber into which the sand blast dust is also exhausted. At *A*, Figs. 1, 2, and 3, is shown such an arrangement. For the two sand blast rooms, a tower, built of rough boards, set on end, is provided. It is about 20 feet high, 5 feet in diameter at the bottom and 3 feet at the top. Exhaust steam discharges into the top of the tower. The dust from the sand blast rooms enters lower down and has a tendency to rise. The steam condenses, mixes with the sand, and both are precipitated. If the door is left open, the wet sand will fall out to be carted away or, it can be carried out on a belt conveyor.

The Sand Blast Room.

The sand blast room is usually about 10 feet square and 10 feet high. The walls should be lined for a short distance with metal to resist the wear of the striking sand. Fresh air should enter from the roof or along the sides near the roof, from several openings, to prevent a draft on the workman. The exhaust should be from the bottom, as shown, to accommodate two rooms. With this arrangement, the

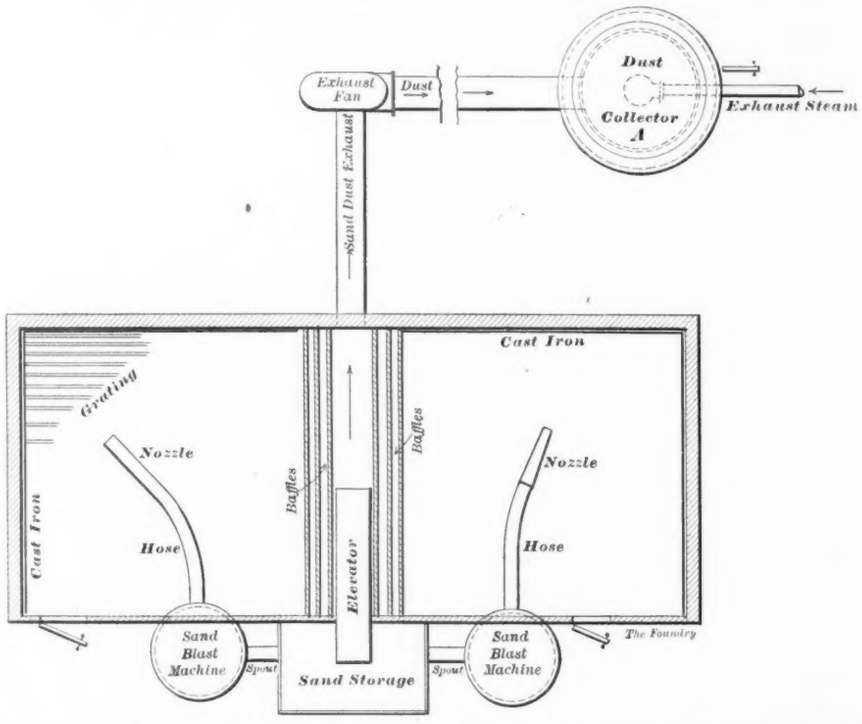


FIG. 1—PLAN VIEW OF SAND BLAST EQUIPMENT OF AN ENAMELED SANITARY WARE FOUNDRY

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication.

Note--This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

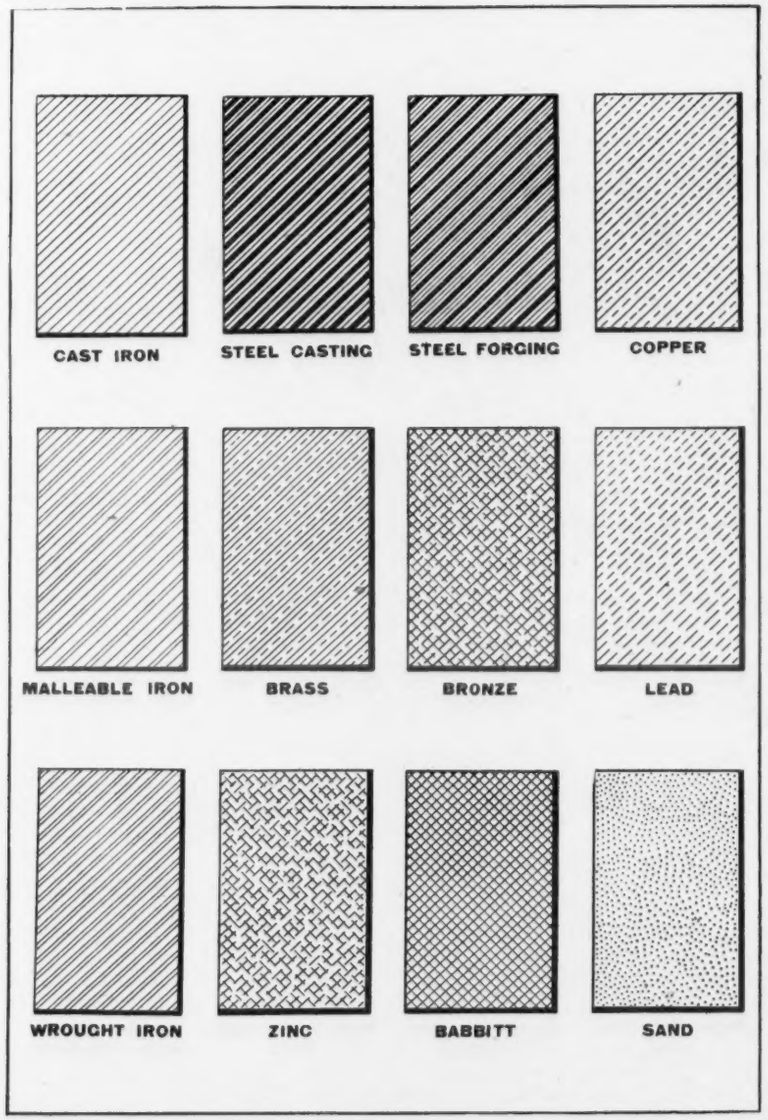
Sizes of Pipes for Tumbling Barrels.

Diameter of mill, inches.	Length of barrel, inches. 36 — Diameter of pipe, inches.	48 — Diameter of pipe, inches.	60 — Diameter of pipe, inches.	72 — Diameter of pipe, inches.	84 — Diameter of pipe, inches.
24	4	4	5	6	6
30	4	4	5	6	6
36	5	5	6	6	7
42	6	6	6	7	8
48	6	6	7	8	8

Diameter of Exhaust Fan Inlets for Tumbling Barrels.

Diameter of pipe to mill, inches.	Number of Mills. 1 — Inlet diameter, inches.	2 — Inlet diameter, inches.	3 — Inlet diameter, inches.	4 — Inlet diameter, inches.	5 — Inlet diameter, inches.	6 — Inlet diameter, inches.	7 — Inlet diameter, inches.	8 — Inlet diameter, inches.	9 — Inlet diameter, inches.	10 — Inlet diameter, inches.
4.....	4¾	6½	6½	8½	8½	10½	10½	12	12	12
5.....	5½	6½	8½	10½	12	12	14	14	16	16
6.....	6½	8½	10½	12	14	14	16	18	18	20
7.....	6½	10½	12	14	16	18	18	20	22	24
8.....	8½	12	14	16	18	20	22	24	24	27

STANDARD SECTION-LINING FOR MECHANICAL DRAWINGS.



workman has an ample supply of fresh air and this minimizes, as much as possible, the rising of the fine dust. In any case, a helmet and gloves must be worn to protect the skin from the sand. This method does away with an aspirator if the proper exhaust fan is used, and the room is occasionally allowed to clear itself of dust entirely. In some plants, two men work in each room. They alternately relieve each other in carrying the castings to and from the room and sand-blasting them.

In exhausting the sand, baffles are introduced to deflect the larger particles into the pit. Only the finest dust then goes up into the fan. The coarser grains flow into the pit and are carried up in an elevator to a storage tank or box to be used over again, as shown in Fig. 3. This sand can also be taken care of in a hopper underneath the floor as indicated by the lines *XX*, Fig. 2.

In this case a grating would be used and no sand would have to be shoveled. It is not desirable to pass the sand so direct as this to the sand blast machine, as a rotary riddle should be installed under the elevator spout to take out scrap, gates, and runners, which would otherwise clog the machine. A very small particle will close the slot in the sand blast machine.

Drying New Sand.

New sand must be thoroughly dried before it is placed in the machine hopper, and this is often done by spreading it out in pans placed over the boiler. If a plant has a number of sand blast rooms, a large steel plate drum is built and set at a slight incline, from 5 to 10 degrees. This has a fire built under it and suitable mechanism is provided to revolve the drum slowly. The sand is shoveled into the drum at one end and rolls over until it finally works out of the lower end, thoroughly dried. A drum, 3 feet in diameter and 15 or 20 feet long will serve for a dozen ordinary sand blast machines, and one man can do all the necessary work. This includes the shoveling of the sand, cleaning it away from the lower end and keeping up a fire under the drum. To obtain the greatest amount of heat, this drum should be arched over with brick, a grate provided near the lower end, and a 12-foot chimney should be placed near the upper end. This will produce a gentle draft and the arch will project the heat against the steel drum as it revolves in this enclosure.

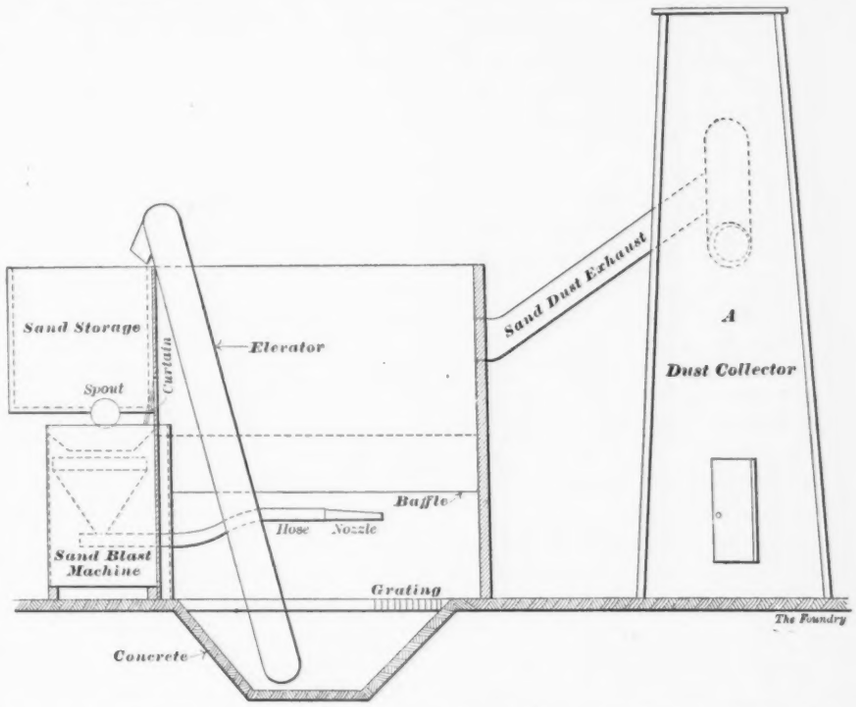


FIG. 3—SECTIONAL VIEW OF SAND BLAST ROOM SHOWING ELEVATOR FROM SAND HOPPER TO SAND STORAGE

The sand blast machines are shown in plan in Fig. 1. When the grating is not used, it is convenient to have the edge of the cylinder set slightly inside the sand blast room. The sand can then be shoveled into the top of the machine through an ordinary sieve. With the system shown, a rotary riddle should be placed under the elevator spout. The sand blast installations of a number of sanitary ware foundries are similar to that shown in Figs. 4, 5 and 6.

It is quite simple in operation. The sand is placed in the upper sand hopper, the air is cut off and the sand inlet valve drops down as shown in Fig. 4. The sand then falls through the inlet *E* and drops down into the lower sand bin. When this is full the inlet valve is raised against its seat by pulling up the ball handle. This is held in position until the compressed air is let into the tank, and when the full pressure of air is on, it is held firmly in place. The air then passes out through the ejector and into the hose. The hand wheel is next given a few turns and this pulls out the sand gate, allowing the sand to fall down into the ejector. The sand and

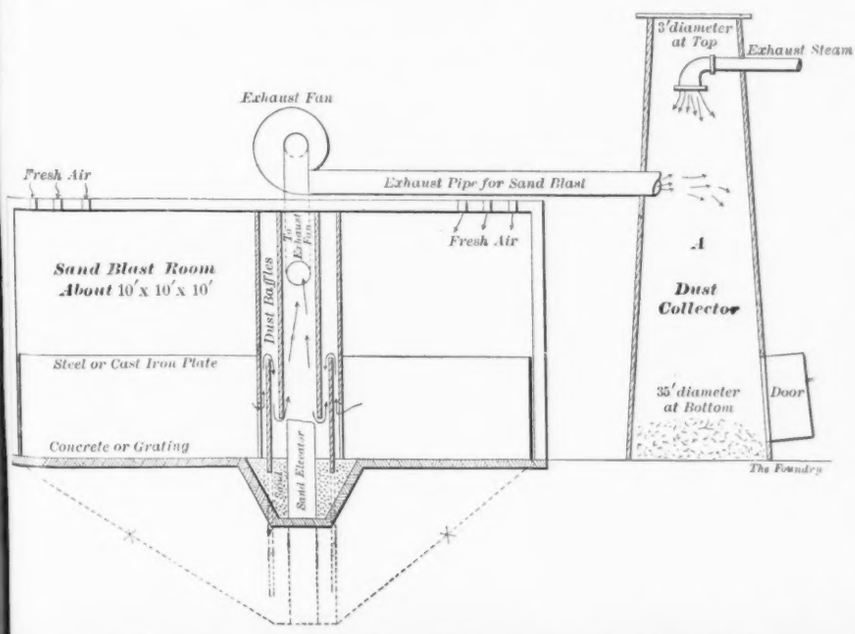


FIG. 2—SECTIONAL VIEW OF SAND BLAST ROOM AND DUST COLLECTOR

air are proportioned by the hand wheel and a lever is sometimes used instead of the wheel, with a set screw as a gage for the sand gate opening. The current of air, under 20 to 30 pounds pressure, carries the falling sand along in a continuous stream and projects it against the casting. The air flows out with a steady pressure, assuming that the supply is kept up, and the outside cylinder, being closed top and bottom, serves as an air reservoir. The machine is built of 3/16 inch steel plates, and the cylinder is 30 inches in diameter and 4 feet 6 inches high for this capacity.

The sand hopper is usually a casting, or a plate and a casting as shown, the latter being preferred as it is more easily machined. The sand bin rests on top of the conical projection of the ejector and is riveted or bolted to it. This is its only support. It is set away from the outside shell 1½ or 2 inches. Hand holes are provided in the shell and also in the sand bin so that the slot, which chokes up if the sand is not dried and screened properly, can easily be cleaned.

The sand bin man-hole is an ordinary curved plate, held in position by the air pressure. The shell manhole must be held in place with a gasket and bolt as shown, or the air will leak out. Air leakage is expensive and difficult to detect, and for that reason all joints should be carefully tested.

Man-holes are frequently provided in the upper sand hopper as well as in the bottom, to facilitate cleaning out. Sand blasts are often built without the support shown. If it is not cast integral with the ejector, it should be braced separately instead of hung from the side alone.

Section *AB*, Fig. 5, shows the inlet for sand from the top hopper as well as the value stem. In section *CD*, Fig. 6, is shown a plan of the gate and method of operation in closing and opening the sand slot. The valve, Fig. 5, is an ordinary cone plug, opening straight away in the valve body. Instead of being bored through the bottom, it is cast closed, and a set

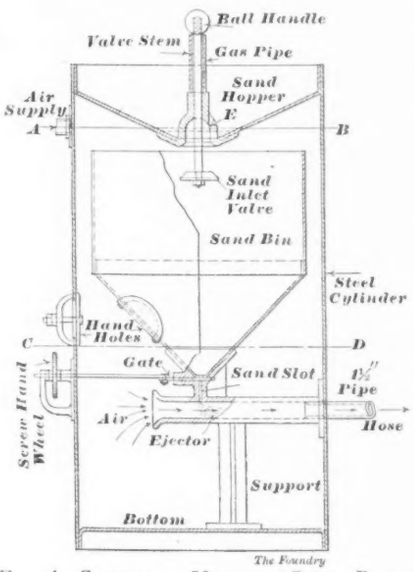


FIG. 4—SECTIONAL VIEW OF SAND BLAST MACHINE AND SAND HOPPER

screw, with a set nut, is screwed up against the plug. This set screw prevents the plug from setting tight to the body and yet it can be made to close absolutely tight. With valves, which draw the air over the seat, the air seems to gradually wear the seat away and thus cause constant leakage.

Grinding the Tubs and Other Castings.

Stationary, flexible and swinging grinders are used to remove the small fins, gates and bumps, which are left on the castings after sand-blasting. The stationary grinder, which is mounted on a center pedestal, has abrasive wheels mounted on each end of the shaft and is used largely for small ware. It is center-driven by a 6-inch belt and the wheels are 2 x 18 inches. The bearings must be long, and if babbitt is used, the best is none too good. A splendid bearing is used in some plants, which consists of a split cast iron bushing. It is a cylindrical shell with a single slot cut lengthwise. Any adjustment can be made against the shaft, as the wear takes place by bringing down the outside box with set screws, and the bushing being in tension, will push away from the shaft. The cast iron used in this box must be high in graphitic carbon, and if the iron has a high percentage of this metalloid it will wear down to a glazed surface. With a minimum amount of lubricant, it will give excellent satisfaction.

Grinding Small Ware.

In grinding small ware, especially sinks and lavatories, which range in weight from 30 to 100 pounds, they may be handled by being counter-balanced through the outlet hole. A chain is led down from the ceiling over a pulley, directly in front of the grinder. This chain has at its end a small flat bar hung in the center. The bar is pushed through the outlet and when pulled up, the bar swings horizontally, preventing the chain from pulling through. A weight on the other end of the chain, after it passes through the ceiling pulley, counter-balances the casting. The workman has then only to push the casting against the grinding wheel, as the weight of the casting is counter-balanced.

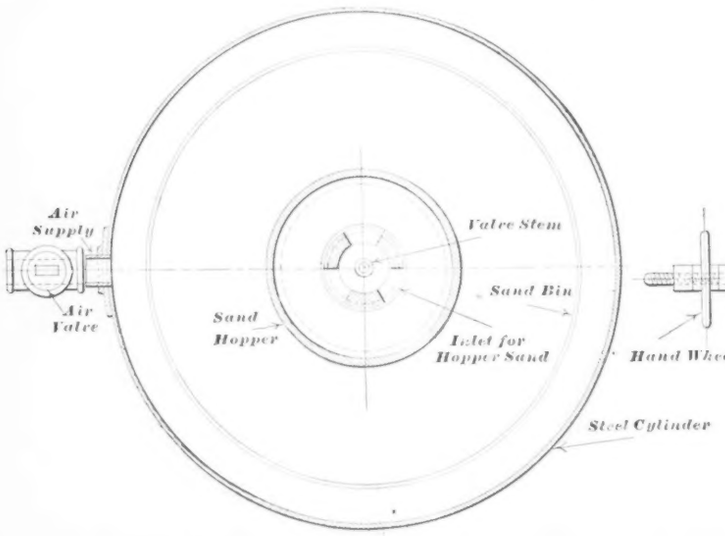


FIG. 5—SECTION *AB*, FIG. 4

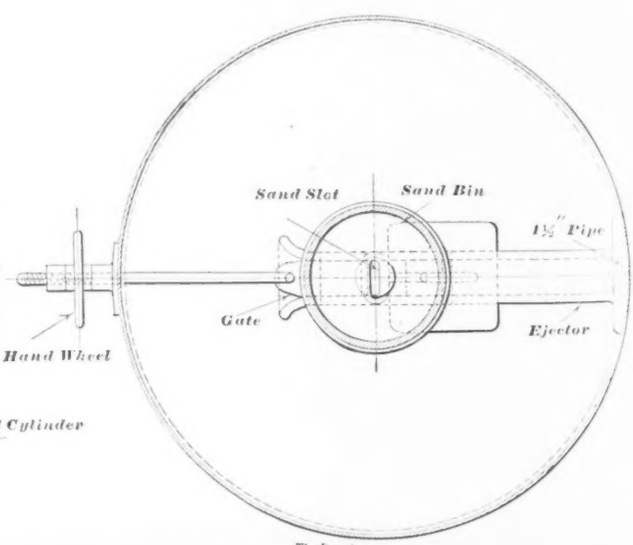


FIG. 6—SECTION *CD*, FIG. 4

The swinging grinder, which is suspended from the ceiling and is pivoted to swing horizontally, is best driven by a flat belt for this class of work. The grinding is heavy and the flat belt requires less repair than the round belt or rope drive. A 2½-inch belt gives excellent satisfaction. The swinging frame, however, as usually furnished, is too heavy to be moved about speedily over this class of work. It should be built of 1¼-inch pipe, with castings ¼ inch thick and designed in proportion to this pipe. A swinging frame, at least one-half as heavy as is usually built, will enable a workman to increase his production materially.

The swinging grinder is used largely on tubs, to grind off the uneven outside surface, and especially the rim. When the tub is poured from the rim the gates do not break off leaving a smooth edge, and the hand-made tub rims also frequently leave bad parting fins.

Use of Flexible Grinder.

The flexible grinder is used for grinding inside the tub and such parts as cannot be reached by the other grinders. It is well adapted for pattern grinding, but in the cleaning room it is usually used for special work. The flat belt also works well on this drive and a belt connected to an overhead countershaft permits the drive to be swung more quickly than a direct-connected electric drive. When the flexible shaft is direct-connected to a motor, the motor should be set on a pivoted table to turn horizontally as desired. An independent bearing should be provided just outside the motor, through which the power is transmitted direct to the flexible shaft.

The work required of a flexible shaft at such a high speed causes considerable wear, but by keeping down the diameter and width of the grinding wheel, the repair bill may be considerably reduced. Wherever possible the wheel should be swung by hand, back and forth, over the surface to be ground, thus preventing the wheel from forming sharp hollows in the casting. The straight outside portion of the rim of the bath tub is the section that receives the closest inspection, so that it is desirable to have this enameled as well as possible. To enamel it properly, the surface must be very smooth. To accomplish this, a special grinding machine is employed. The fins and sharp lugs are first ground off the tub with a swinging grinder, and the tub is then ready for the rim-grinding machine. This machine is direct driven by two individual motors, Figs. 7 and 8. The five-horsepower motor travels about 1,200 revolutions per minute, and the two-horsepower motor is geared down to operate the tub table about 6 feet per minute. A special shape grinding wheel is used for each change in the size of the roll of the rim, that is, a 3-inch and a 2½-inch rim will require different shape wheels.

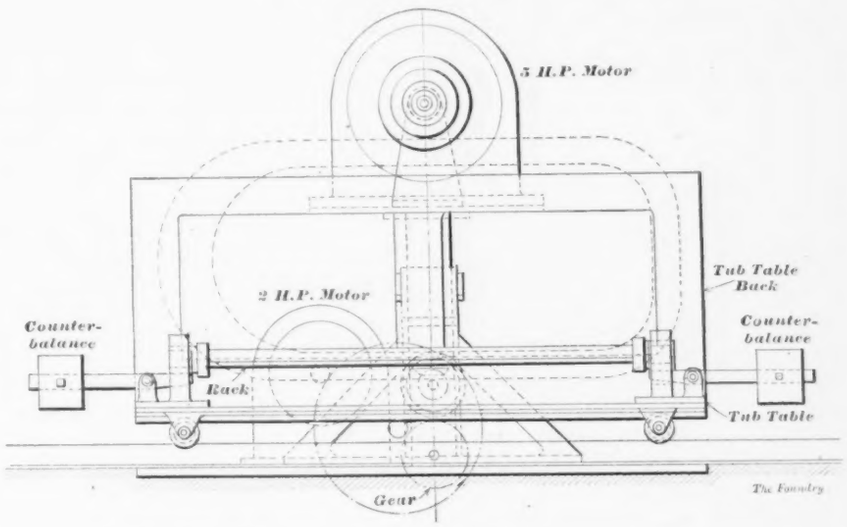


FIG. 8—SIDE ELEVATION OF BATH TUB RIM GRINDING MACHINE

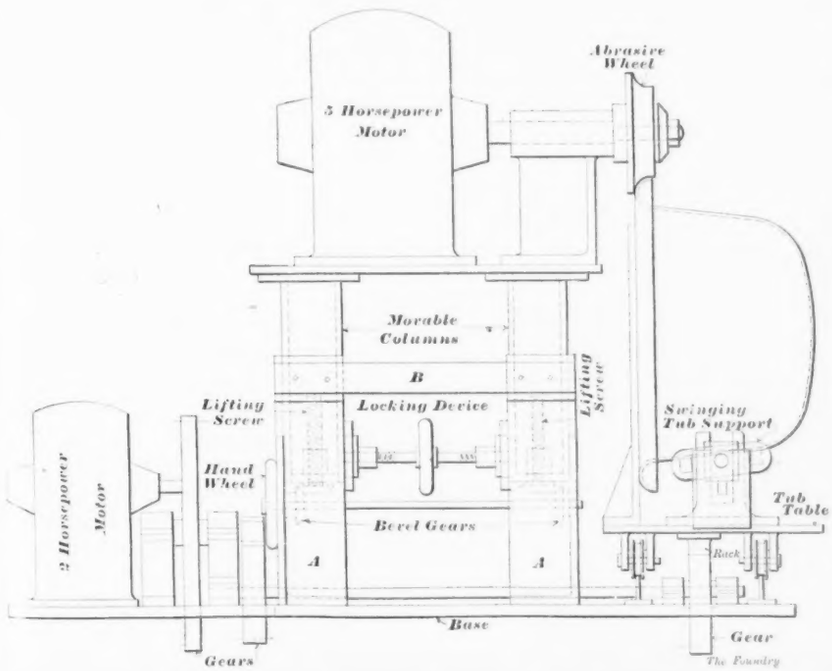


FIG. 7—BATH TUB RIM GRINDING MACHINE

The grinding wheel motor is set on top of a table, which is in turn fastened to two square columns. By means of the lower-hand wheel operating the bevel gears attached to the lifting screws, the grinding wheel and motor are raised and lowered to suit the width of the tub.

When in the proper position, the columns are locked in place by the center hand wheel operating right and left hand screws to force the cast iron shoes out against the pedestal *A*. The top is held by braces *B*, while the bottom of the pedestal is screwed to the base. This provides a rigid construction for the grinder, which, traveling at a high speed, would otherwise loosen up the lifting screws. No change is made for tubs of the same width, as any ordinary variation is taken up by the

counter-balances shown in Fig. 8.

The two-horsepower motor operates the tub table. This should be a reversible motor so as to operate the table in either direction. The speed is reduced by a set of gears, which engage a rack screwed to the under side of the table. The gears and rack should all be machine cut to insure the smooth and uniform movement of the table.

The table moves back and forth on top of planed steel rails. These are set above the floor level. The tub table proper consists of two large castings. The back, as shown, is planed so that the rim of the tub, in time, will touch all around, and acts as a guide to hold the rim in correct alignment with the grinding wheel. In operation, the tub is placed on the table, and the swinging support accommodates itself to the slope of the side of the tub and acts as a slight wedge to force the tub down and against the table back. This support swings in bearings at each end and under each bearing, the counter-balancing lever raising the tub up in contact with the grinding wheel. This has a limited range, but is enough to follow the curves of the tub for a short distance at each end. The workman usually steps on the counter-balance as the tub enters and leaves the grinding wheel.

After the tub is in place the table motor is started and the tub passes under the grinding wheel. This surface, unless left unusually rough by the swinging grinder, is finished in one operation. When operated properly, the rim comes out as if planed for a template. After passing through, the tub is rolled off on a small truck, which is made to act as a turn-table, and the tub is put back on the table for grinding the other rim. This is done very quickly as the truck is about the same height as the tub table, and the two men handling the machine become very skillfull in handling the tubs. After the tub is back in place, the table motor is reversed and the table moves back with the tub under the wheel. There is no loss for the return stroke, as it were, as the table is operated in either direction.

Too much cannot be said about the excellent work of this machine, as it corresponds to the precision grinding of the machine shop, and when it is realized that all excrescences are magnified after the enamel is sifted over them, the value of the machine at once appeals to the progressive enameled ware manufacturer.

THE TENSILE STRENGTH OF ALUMINUM-ZINC ALLOYS*

By WILLIAM D. BANCROFT

THE alloys of aluminum and zinc having found some application in the manufacture of castings it seemed desirable that a more complete investigation be made of their physical properties. A metal known as "Alzinc," consisting of two parts of aluminum and one of zinc, has found some use as a substitute for brass in foundry work. This composition was undoubtedly chosen as a result of the investigation carried on under the direction of Prof. R. C. Carpenter and reported by him to the American Society of Mechanical Engineers in June, 1898.[1]

In practice it has been found that alloys of about 75 per cent make sharp castings, have comparatively low melting points and fair strength. The fact that sharp castings are obtained with this composition is probably not due so much to the expansion on cooling, a statement which is sometimes made, as to the superior casting properties of the metal. The latter are due to increased fluidity and lesser surface tension. These alloys take a high polish, do not readily tarnish in the air, and are easily worked on the lathe and planer.

The only systematic investigation of the strengths of the aluminum-zinc alloys which seems to have been carried on up to the present time was that under the direction of Prof. Carpenter. The curve reproduced in Fig. 1 is taken from his report. It was based on the tension tests of some fourteen pieces and hence does not seem conclusive. The present investigation was therefore undertaken.

Realizing the great influence which even small amounts of impurities have at times on alloys, special precautions were taken to use metals as pure as possible and to guard against contamination in the melting process. The aluminum used was furnished by the Pittsburg Reduction Co. and was about 99.9 per cent pure. The zinc was "Bertha Pure Zinc" which contained not over 0.2 per cent impurities. On account of the great affinity of aluminum for silicon it was not feasible to melt the metals in the ordinary Hessian clay crucible, nor could the usual graphite crucible be used on account of its clay binder. Bars of artificial graphite were therefore obtained and pure graphite crucibles were made from these. They were about 4 inches outside diameter and 6 inches high, holding from four to five pounds of metal. They are easily prepared, the graphite working nicely on the lathe.

Melting the Alloy.

The melting was done in a small gas furnace provided with an air blast. The surface of the charge was guarded from oxidation by introducing illuminating gas through a pipe, thereby maintaining a reducing atmosphere in the top of the crucible. In some of the earlier melts the additional precaution was taken to cover the surface of the metal with powdered carbon, but this was later found unnecessary, provided care was taken not to overheat. Little trouble was experienced by the burning out of the zinc, the test pieces in most cases analyzing very close to the composition they were cast for.

When the charge was completely melted the crucible was removed from the furnace and a porcelain tube containing the junction of a thermocouple was introduced into the alloy. Using this tube as a stirrer, the metal was thoroughly mixed as it was allowed to cool, and when a temperature 50 degrees Cent. above the freezing point for that particular alloy was reached, it was quickly cast in a specially prepared mold. The freezing points were obtained from the equilibrium diagram as developed by

*Presented at the Cincinnati Convention of the American Brass Founders' Association.

[1]Transactions A. S. M. E., 19,551 (1897-8).

E. S. Shepherd† and reproduced in Fig. 2.

Structure of the Cast Metal.

As may be expected most of the difficulties which have arisen during the investigation have been met with in casting. The alloys at the zinc end of the series developed the coarse crystalline structure characteristic of commercial cast zinc. It is obvious that such a structure is not capable of resisting much strain. Furthermore, castings of the same composition did not always give the same crystalline structure even when cast under apparently the same conditions. They varied from the usual "radial structure" to those showing much finer grain, in which the crystals were very fine and nearly alike in all dimensions. These latter pieces were found to give a much higher tensile strength. It was therefore necessary to find some means by which the finely crystalline structure could be produced at will. The exact control of the temperature of pouring did not seem feasible at that time, so the effect of pressure was tried to see if it would check the growth of the crystals. Very long molds were constructed, the longest about 30 inches long and about ½ inch in diameter. The lower few inches of metal would then be under considerable pressure at the time of freezing and crystal growth should be somewhat checked. The results were far from satisfactory. No perceptible difference either in structure or tensile strength could be

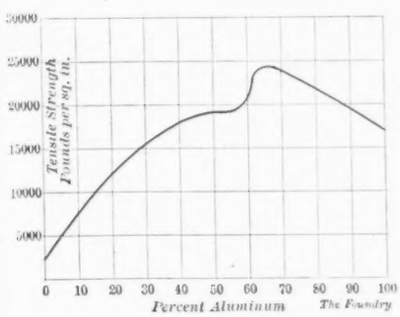


FIG. 1—RESULTS OF TENSILE TESTS OF ALUMINUM-ZINC ALLOYS MADE BY PROF. R. C. CARPENTER

detected between the upper and lower portions of the casting.

Experiments.

The well-known process of crystal innoculation or "seeding" was next resorted to. The metal was poured into the mold when very mobile, and then at the moment of solidification a piece of finely crystalline rolled zinc was thrust down into the center. Results from this were also negative.

Another expedient attempted in order to avoid cooling and promote rapid freezing was to agitate the mold

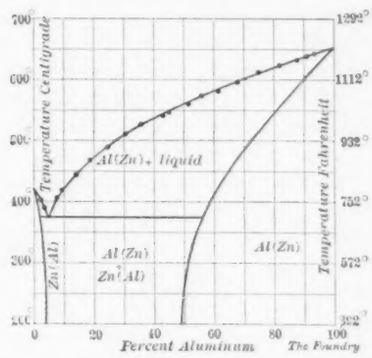


FIG. 2—EQUILIBRIUM DIAGRAM DEVELOPED BY E. S. SHEPHERD, SHOWING FREEZING POINTS OF ALUMINUM-ZINC ALLOYS

during the freezing process. Rocking, tapping, and stirring were all tried, but with as little success as before.

Molds at Freezing Temperature When Metal Was Cast,

It was then decided to pour the metal into an ice-cold mold at a temperature as near its freezing point as possible. This method gave the desired result. The procedure in more detail was as follows: The alloy was poured at a temperature, 50 degrees Cent. above its freezing point, into an artificial graphite mold. The two halves of the mold were of graphite slabs held together by slipping them endwise into a metal jacket. This was then placed in ice water and allowed to chill thoroughly before the cast was made. As soon as possible after pouring the mold was opened and the pieces plunged into ice water. The whole operation from the beginning of pouring, required less than one minute. Two pieces were cast at one time. They were cylinders about 1⅛ inches in diameter by 8 inches long.

Tensile Test.

The pieces thus obtained were then prepared for the tension test. They were reduced to about 6½ or 7 inches in length, thereby removing any piping, which at times extended to the depth of an inch and rough turned to 1 inch in diameter. The center, for a distance of about 3 inches, was then carefully turned to 7/10 inch. The real diameter was taken with a micrometer reading to 0.001 inch. The last two turnings from the center of the test pieces were carefully preserved and used for analysis. This was done in the electrolytic way, using a sodium zincate solution from which the zinc was deposited and afterwards weighed. The aluminum was determined by difference.

The pieces were tested on a 100,000 pound, double screw, power-driven, Riehle machine. In all cases the slowest speed was used. The results of the tests are shown plotted in Fig. 3.

As the result of a study of Shepherd's equilibrium diagram it was decided that the curve of tensile strengths would in all probability consist of three separate parts. Again referring to Fig. 2 it is seen that the alloys of the series, besides being different in chemical composition, are also different in constitution. Up to a limiting value of about 4 per cent aluminum the alloys consist of a solid solution of aluminum in zinc of varying concentration. From a limiting value of about 50 per cent aluminum and extending up to pure aluminum, the alloys consist of a solid solution of zinc in aluminum of varying concentration. Between the limits of 4 per cent and 50 per cent aluminum the alloys consist of two solutions of the limiting concentrations. It might be expected then, that varying with the composition of the alloy, each of these three regions would have an independent branch of the curve of tensile strength. As

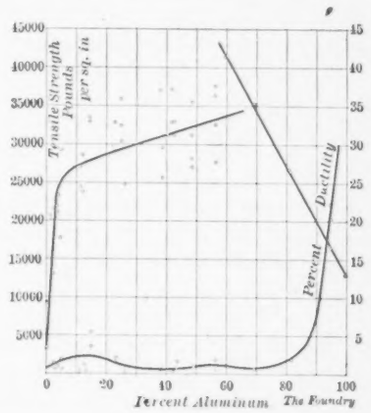


FIG. 3—RESULTS OF A SERIES OF TENSILE TESTS OF ALUMINUM-ZINC ALLOYS CONDUCTED BY THE AUTHOR

Carpenter's curve gives no indication of this, especially at the high zinc and where his samples were far apart in composition, a large number of pieces were made with high zinc content. The results obtained agree quite well with the theory.

Metal Rapidly Cooled.

The values obtained for alloys of from 50 to 70 per cent aluminum

†E. S. Shepherd, Jour. Phys. Chem. 9,504 (1905).

evidently depend to a large extent upon the rapidity of cooling the melt. With exceedingly rapid chilling and the retention of a super-saturated solution the values are high and fall upon an extension of the curve to the right, while with more moderate quenching they fall upon the curve for the central region. The exact forms of the curves, especially for alloys between the above mentioned compositions, are not yet definitely established. It is hoped that the investigations now progressing, in which annealed pieces are made use of, will settle the matter.

Ductility of the Alloy.

The ductility of the alloys is also shown in Fig. 3. It will suffice for the present to state that for specimens which have been annealed, the ductility is considerably increased with only slight loss in tensile strength.

In conclusion, it might be said that the alloys throughout the series, if chill cast and quickly quenched thereby assuming small crystal size, possess strengths considerably greater than usually obtained. The values given by Prof. Carpenter are in all cases much lower than those obtained from such test pieces excepting when these pieces approach the pure aluminum end of the series. Here Prof. Carpenter's results are higher. This is undoubtedly due to the fact that his aluminum, in all probability took up silica from the crucible and was no longer pure material. Most of our alloys show strengths running from 25,000 to 35,000 pounds per square inch, while Prof. Carpenter obtained 25,000 as a maximum value. With pure zinc, strengths of about 9,000 pounds are obtained.

In melting metals, the temperature should never go above 700 degrees Cent., as above this limit the aluminum takes up carbon quite appreciably.

The experimental part of the work has been done chiefly by W. B. White, and is now being finished by V. Skillman.

We are indebted to G. B. Upton, of Sibley College, for much assistance in connection with the testing. The expenses of the investigation have been defrayed by a grant from the Carnegie Institute.

DIAGRAMS OF MIXTURES FOR THE BRASS FOUNDRYMAN

By J. F. BUCHANAN

WE ARE living in a graphical age when diagrams and pictures can be made to represent with force, and a certain amount of realism, all the facts and many of the fancies, which stand for progress and pleasure in life. Forgetting, for the moment, the knights of the fountain pen brigade—the press reporters—who vie with each other in constructing lurid word pictures, we will center our thoughts on the advantages of putting "line upon line," as well as "precept upon precept," in the making of graphs, or quantity diagrams, for every-day practical use in foundry operations.

A graph has been defined as "a line drawn on a diagram so as to exhibit the nature of the relation between two connected variables." It is now generally conceded that graphs and graphic methods are of great importance in practical work, as well as in scientific investigations, but the writer has so far failed to observe anything like undue haste in "filling the bill" for the *practical* side of foundry interests. On that account some of the diagrams submitted in this article may appear to contain the essence of novelty. No such claim is made; they are simple applications of the graphic method to foundry practice and calculations, and if others can be stimulated to widen the field, then the foundry trade will be kept in line as a branch of modern engineering.

The first diagram, Fig. 1, shows the relative proportions of copper and zinc in the standard brass alloys. The use of this graph has enabled our furnaceman, and he is a good one, but no hand at figures, to weigh any quantity of copper and to know instantly the correct amount of com-

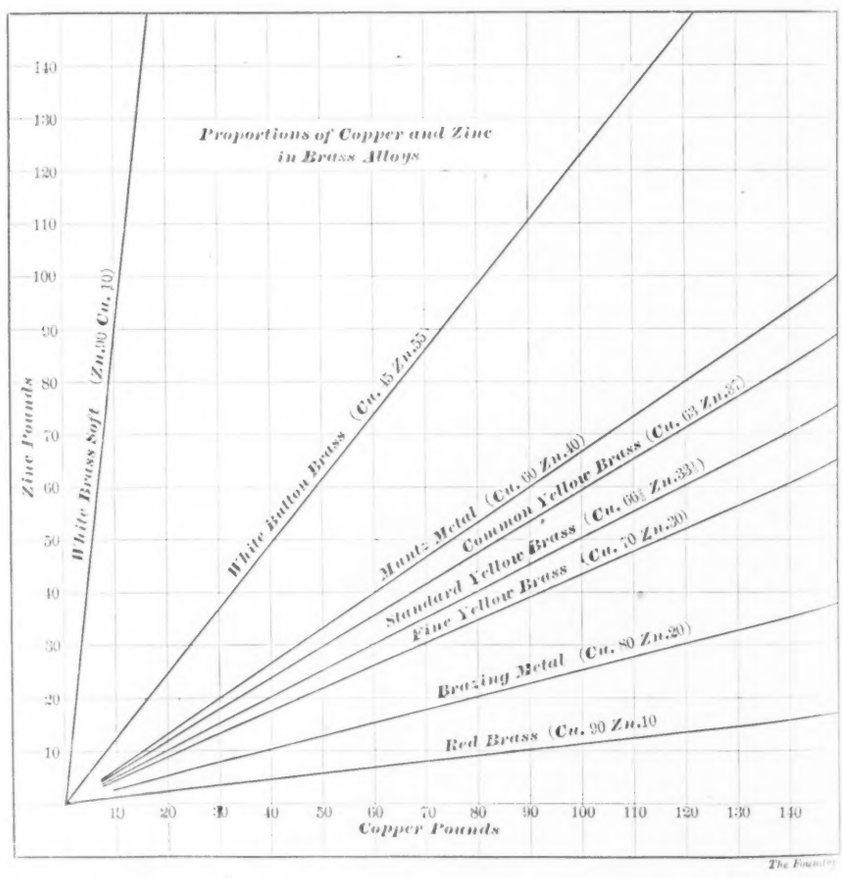

Proportions of Copper and Zinc in Brass Alloys
Zinc Pounds
Copper Pounds
White Brass Soft (Zn.90 Cu.10)
White Button Brass (Cu.15 Zn.85)
Muntz Metal (Cu.60 Zn.40)
Common Yellow Brass (Cu.67 Zn.33)
Standard Yellow Brass (Cu.66⅔ Zn.33⅓)
Fine Yellow Brass (Cu.70 Zn.30)
Brazing Metal (Cu.80 Zn.20)
Red Brass (Cu.90 Zn.10)
10 20 30 40 50 60 70 80 90 100 110 120 130 140

FIG. 1—DIAGRAM SHOWING RELATIVE PROPORTIONS OF COPPER AND ZINC IN THE STANDARD BRASS ALLOYS

position required to produce the alloy required. One feature of the diagrammatic mixture sheet is that it requires very little explanation, or, as our furnaceman aptly put it, "It's as easy as reading the clock."

Fig. 2 is similar to Fig. 1, the metal tin replacing zinc in bronze alloys. Speculum is not much used nowadays, but the same proportions make excellent "hardening" for genuine babbitt metal alloys, and for that reason it is included.

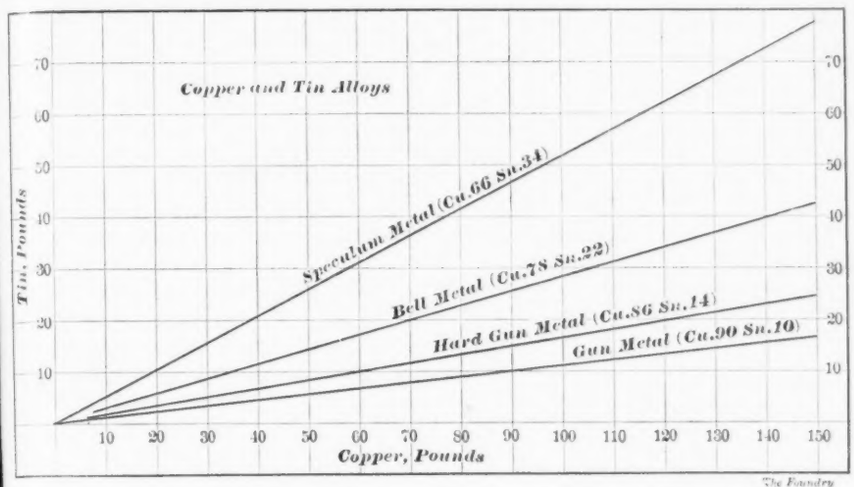


FIG. 2—RELATIVE PROPORTIONS OF COPPER AND TIN IN BRONZE ALLOYS

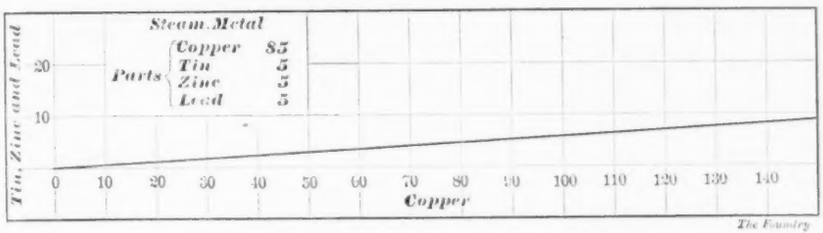


FIG. 3—DIAGRAM OF STEAM METAL MIXTURE

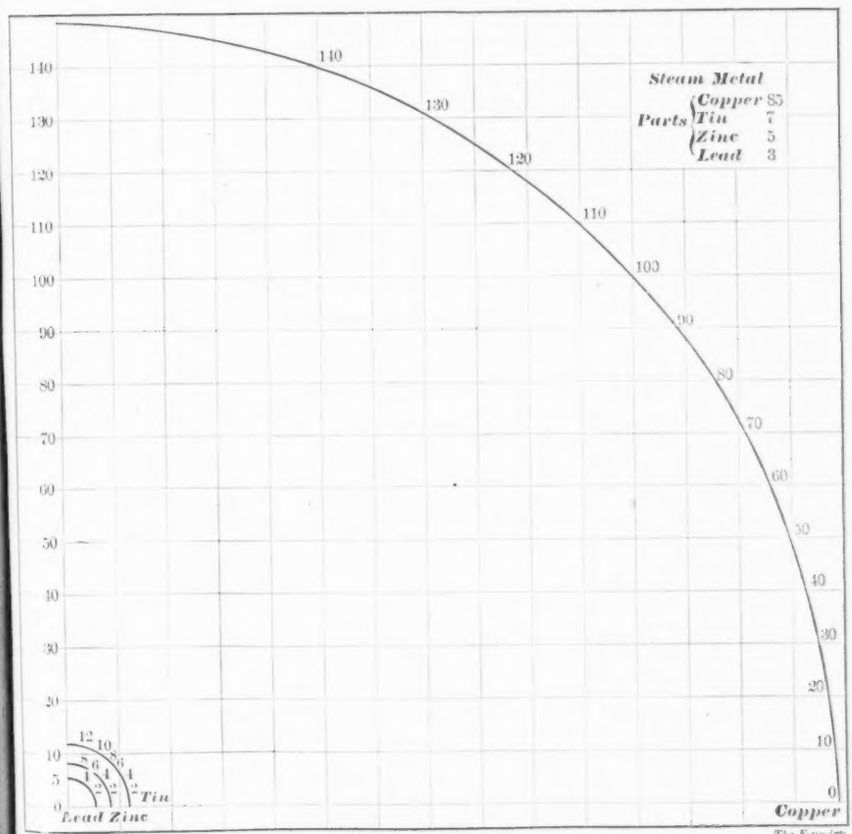


FIG. 4—DIAGRAM OF A STEAM METAL ALLOY IN FOUR PROPORTIONS

Ounce Proportions.

In Fig. 3 we have still the same diagram with a proviso. Suppose an alloy of copper and two or three other metals is wanted, the latter in equal quantities, as for instance, "ounce" metal, which consists of copper, 16 ounces; tin, one ounce; zinc one ounce; lead, one ounce; or naval bolt metal, which is, copper, 14 parts; tin, one part; zinc, one part. The graph is set to the 16 to 1 ratio, or the 14 to 1 ratio, and the proportions of tin, zinc and lead being equal, come out on the same horizontal line. The example given in Fig. 3 is for a steam metal mixture of copper 85 per cent, tin 5 per cent, zinc, 5 per cent and lead 5 per cent. Where the proportions of the composition metals in the alloy vary,

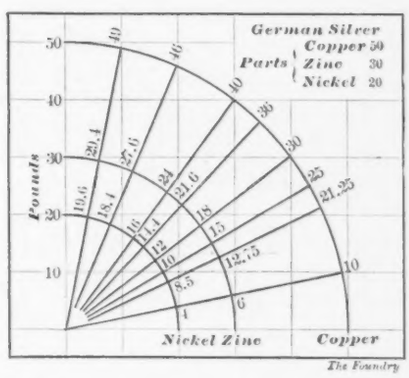


FIG. 5—DIAGRAM OF A GERMAN SILVER MIXTURE IN THREE PROPORTIONS

a different kind of graph must be constructed.

Steam Metal in Four Proportions.

Fig. 4 illustrates a steam metal alloy in four proportions, and Fig. 5 shows the composition of a German silver mixture, at various points, in three proportions. Thus it will be seen that an important use of graphs is to enable us to obtain formulas showing the relations between quantities which are connected with each other. Prof. A. Humboldt Sexton, Glasgow, demonstrated some years ago that those metals having high atomic volumes were the best for anti-friction purposes. It has also been contended by scientists that alloys of the metals according to their atomic weights are more homogeneous than average mixtures. Parsons' manganese bronze is said to be produced in atomic proportions. The diagram, Fig. 6, illustrates the

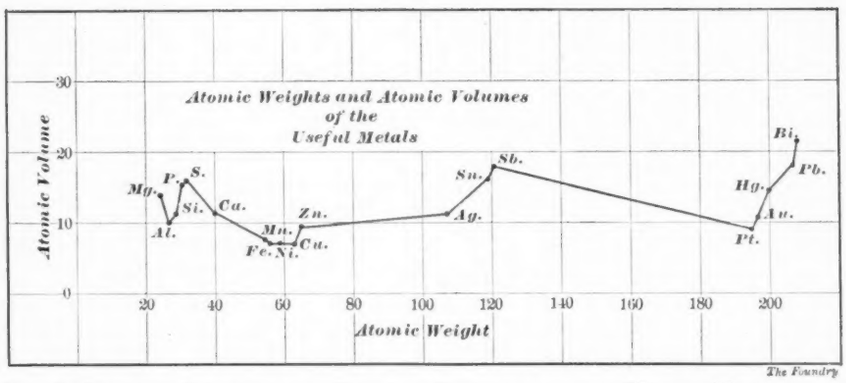


FIG. 6—DIAGRAM SHOWING THE RELATIVE POSITIONS OF THE USEFUL METALS WITH REGARD TO THEIR ATOMIC WEIGHTS AND ATOMIC VOLUMES

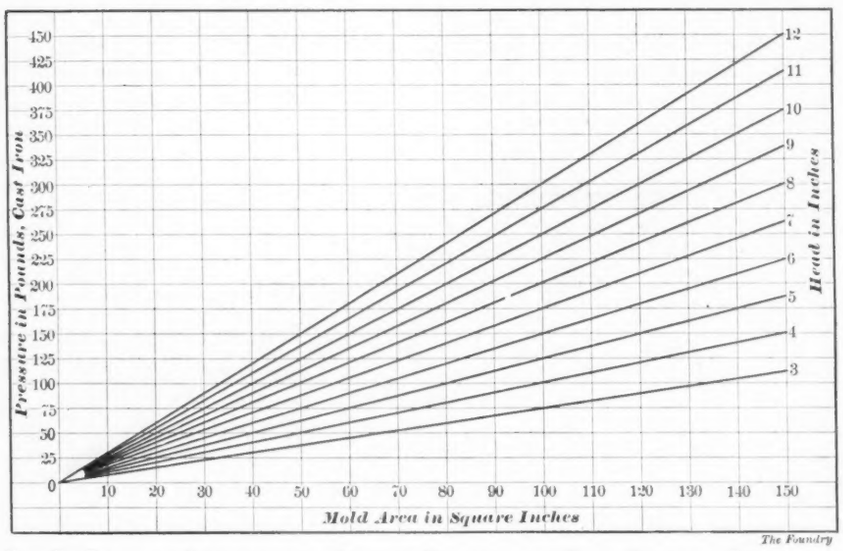


FIG. 7—DIAGRAM SHOWING THE LIFTING PRESSURE ON FLAT COPES IN RELATION TO THE METAL, THE SURFACE AREA AND HEAD OF THE MOLD

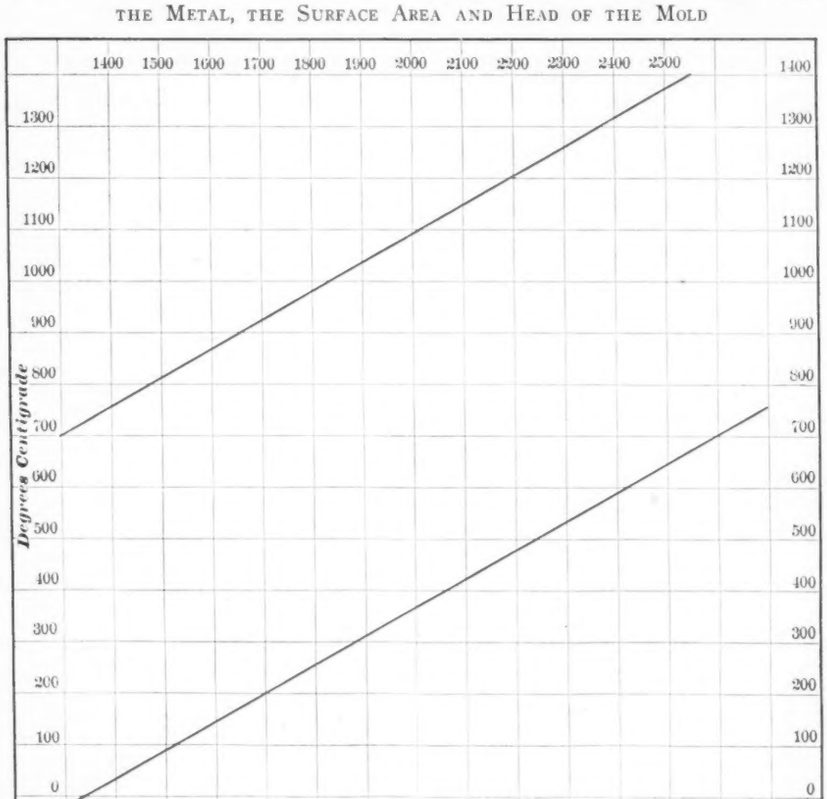


FIG. 8—DIAGRAM FOR THE CONVERSION OF CENTIGRADE TO FAHRENHEIT AND FAHRENHEIT TO CENTRIGADE

relative positions of the useful metals with regard to their atomic volumes, and their atomic weights. The formula for finding the atomic volumes is as follows:

$$\frac{\text{Atomic Weight}}{\text{Specific Gravity}} = \text{Atomic Volume.}$$

The divisions for atomic weights in the diagram are based on the International Table of 1907.

Weighting Copes.

The weighting down of copes is a "variable," which is *very* variable indeed. It varies with the surface area of the mold, with the height of the cope, with the displacement due to cores and other causes, and it also varies with the metal poured into the mold. A graph to suit all these conditions would be too confusing for practical work, but for flat copes and a limited mold area, it is possible to construct a diagram, which would satisfy the conditions and settle the vexed question of weighting down molds.

Fig. 7 shows the lift of flat copes in relation to the metal, the surface area and head of the molds. This is based on the rule that the lift is equal to one-quarter of the area of the mold in square inches multiplied by the head, or distance to the free surface of iron in the gate. Briefly, the rule is $\frac{A\ H}{4} = P$, where A = area in inches; H = head in inches, and P = pressure (or lift) in pounds. Here, 4 cubic inches of cast iron are taken as weighing 1 pound, and the extra weight of the cope itself is allowed as an additional factor of safety.

Conversion of Temperatures.

Fig. 8 is a graph for the conversion of temperatures. The two principal scales for temperatures, Fahrenheit and the Centigrade, can be converted on this diagram up to the temperature of molten cast iron. The line is cut in two for convenience in reading off degrees, and also to save space.

Annealing Temperatures.

From the foregoing examples it should be readily seen that graphs have their uses in the workshop as well as in the school or laboratory. Given two variables of such form that the one varies uniformly with the other, then a straight line, or graph, on squared paper, can be made to answer hundreds of problems in arithmetic within the limits of the scale used.

But it is not in calculations only that the convenience of graphs may be demonstrated. Figs. 9 and 10 are graphs of comparison showing actual and ideal conditions in an oven used for annealing steel castings. Fig. 11 shows a unique jig used in locating the halves of patterns in perfect register on molding machine plates, and Fig. 12 gives a comparison of the tensile strength and elongation of various standard alloys, based on tests made by several well-known authorities.

These examples should suggest further uses for graphs in foundry work. For instance piece-work prices could be paid as per graph, and when the man called at the pay office he could be the more easily satisfied that he was receiving his due, because he would be able to see the position.

It is pleasing to find in modern times some remnants of sanity in the handling of figures at school. The metric system and the construction and uses of graphs are now included in every ordinary school course. Diagrams and graphic methods provide a means whereby statistics and other dry-as-dust matters may be presented in more palatable and concise forms than would be possible with stacks of tiresome figures. One slight disadvantage, however, attaches to the graph, in that for intermediate quantities, or fractional proportions, only approximations are possible. Sometimes this can be got over by the use of a very large unit, but this is not always convenient. In the majority of cases it is possible to come as near to the proportions as would be obtained by tedious arithmetical methods. By constructing the graph on the regulation squared paper, 10 squares per inch, and by laying a rule graded to one-hundredth parts of an inch, on the diagram, the various proportions may be read off correctly to the nearest decimal fraction.

Patternmakers' Diagram.

Fig. 13 is a straight line graph showing the proportions of a standard babbitt metal. Fig. 14 is useful for reference in the patternmakers' department, especially for large work which is beyond the range of the ordinary contraction rule. The writer thinks by these very simple examples the practical application of graphs and graphic methods to foundry work has been demonstrated. Further examples and other uses of graphs can easily be found by submitting the standard foundry formulae to the graphical methods. Finally, attention is directed to a new and simple method of finding the square root of any number, devised by W. Mudie, Edinburgh, in the hope that it be of advantage in finding the ordinates for those who prefer to plot the curves of the algebraical functions in the usual way.

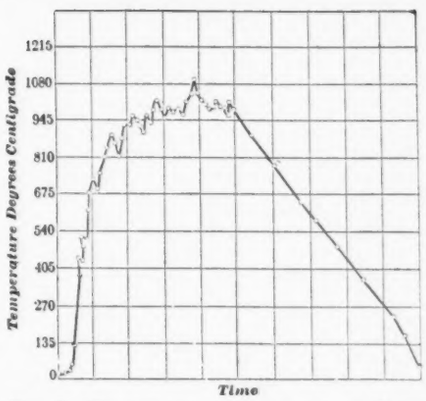


FIG. 9—TEMPERATURE CURVE OF AN OVEN FOR ANNEALING STEEL CASTINGS

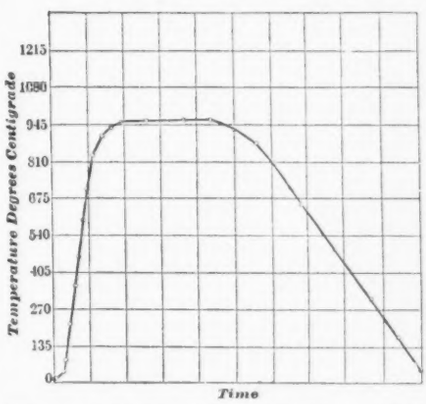


FIG. 10—CURVE SHOWING IDEAL TEMPERATURE FOR ANNEALING STEEL CASTINGS

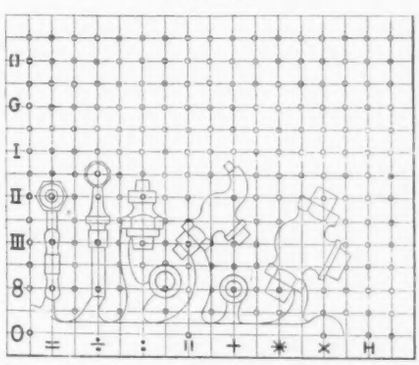


FIG. 11—JIG FOR LOCATING PATTERNS ON PATTERN PLATES

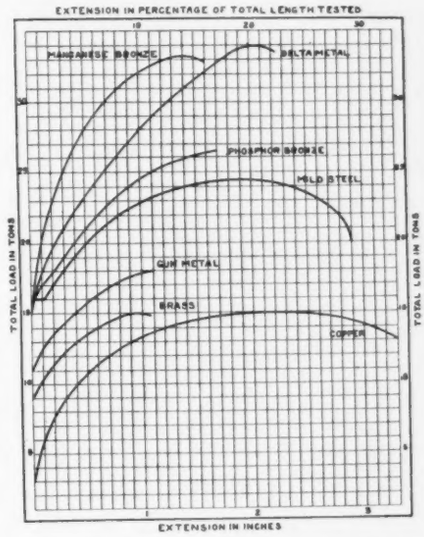


FIG. 12—DIAGRAM SHOWING TENSILE STRENGTH AND ELONGATION OF VARIOUS STANDARD ALLOYS

To Find Square Root.

To find the square root of any number draw any two straight lines, Fig. 15, at right angles to each other as *OX* and *OY*. On *OX* set off any number of units, as 1, 2, 3, 4, etc. The figures on *OY* are found thus: $O1 = OA$; $O2 = A1$; $O3 = A2$; $O4 = A3$; $O5 = A4$, and so on. Also below *OX* put the square numbers as in the illustration. If the number whose root is to be found is *OY*, the distance from *O* to that number is the root required; but if not, as say 17, measure from 9 on *OX* to 8 on *OY* and that distance is the root required, because $9 + 8 = 17$; or measure from 16 on *OX* to 1 on *OY*, because $16 + 1 = 17$. For the root of 29 measure from 25 on *OX* to 4 on OY, because $25 + 4 = 29$, and so on.

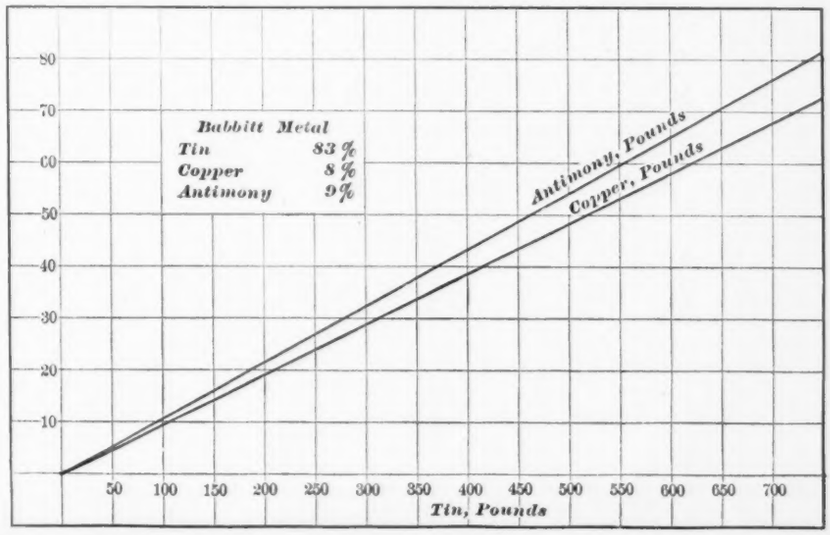


FIG. 13—DIAGRAM SHOWING THE PROPORTIONS OF TIN, COPPER AND ANTIMONY OF A STANDARD BABBITT METAL

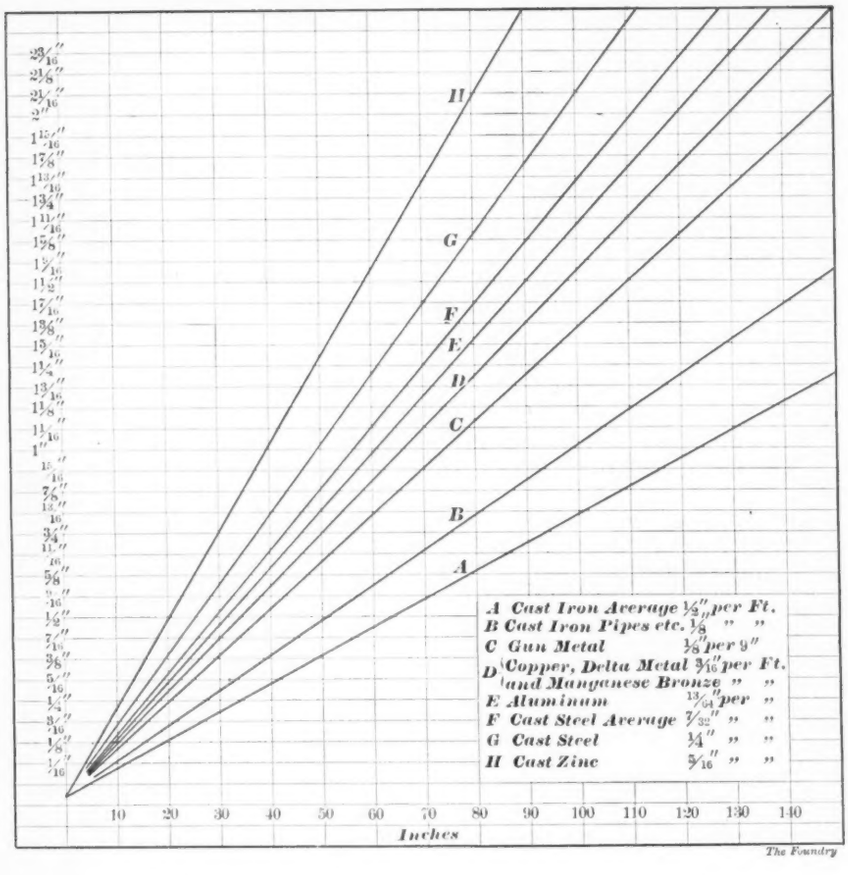

H
G
F
E
D
C
B
A
A Cast Iron Average ½" per Ft.
B Cast Iron Pipes etc. ⅛ " "
C Gun Metal ⅛" per 9"
D Copper, Delta Metal and Manganese Bronze 3/16" per Ft.
E Aluminum 13/64" per "
F Cast Steel Average 7/32" " "
G Cast Steel ¼" " "
H Cast Zinc 5/16" " "
10 20 30 40 50 60 70 80 90 100 110 120 130 140
Inches
The Foundry

FIG. 14—DIAGRAM SHOWING THE CONTRACTION OF VARIOUS METALS

If we wish to express the distance thus found in numbers we produce *OX* to X^1 one unit, and divide it into 10 equal parts. We thus form a scale from which the distance may be measured in units and decimal parts of a unit.

DRY SAND FACING FOR BRASS CASTINGS.

Question:—Can you give us a good formula for dry sand facing for making sharp, smooth, light castings in yellow brass, such as chandelier work? We would like to mix about a barrel at a time.

Answer:—Any of the prepared sands offered for sale are suitable for use as a facing in making fine brass castings. Most of the sands come in powdered form, are of a dark, reddish-brown color, as fine as flour, and produce very smooth, sharp castings. The powder is mixed to the proper temper with clear water in most cases, and if the molds are to be skin dried they are sprayed with stale beer or molasses water before torching. If the molds are to be dried in the oven or baked at a stove, it may be found necessary to mix the sand with molasses water first, to give it bond, so that the impressions will withstand the rush of the metal. The quantity of molasses to be used is variable and depends upon the character of the work. Generally, sufficient is used to give the water the color of weak coffee. The writer has frequently used the proportions half water, half molasses for false core work. In the latter case the cores must be thoroughly baked or they will blow. Very fine work is usually printed-back, because it is so easy to get rough castings with the very finest of sand. If the latter is a little too damp it does not lay close to the pattern. This is especially the case where the sand is rubbed through the sieve with the hand. In this case the sand is extruded through the screen in little lumps, which require very careful ramming to amalgamate. The sieve, therefore, should be shaken, and the sand sufficiently dried to pass through when fine castings are desired without printing-back. The latter is quite easy when the face of the casting is in the cope. When the latter is lifted off, the impression is sprayed with molasses water, then dusted dry with fine sand shaken from a fine bag. On top of this the parting material is dusted, the cope closed and re-rammed with a butt rammer, and when lifted off it is finished and skin dried. Sometimes plaster of Paris is mixed with the sand in the dusting bag in the proportion of half and half. While it produces smooth work, it has the disadvantage of spoiling the color of brass castings. K. K.

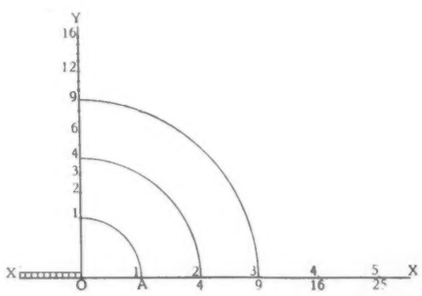


FIG. 15—A GRAPHIC METHOD FOR FINDING THE SQUARE ROOT OF ANY NUMBER

WHITE METAL FOR PLUMBERS' GOODS.

A new white metal for plumbers' goods which it is claimed is nearly as white as silver, and can be successfully used for casting such plumbers' goods as faucets, cocks, and valves, at a less cost than they can be made in brass and nickel-plated is the subject of a patent recently granted. The alloy consists of copper, 60 per cent; zinc, 23 per cent; nickel, 12 per cent; lead, 5 per cent; aluminum, 1½ per cent, and white arsenic, 1½ per cent. The copper is melted in the crucible and 3½ parts of the charge consisting of borax is added. The white arsenic is then stirred in and finally the nickel is introduced. When melted the zinc, lead and aluminum are added, and the mixture is ready for casting.

MIXTURES FOR BEARING METALS.

Question:—Will you kindly give us a babbitt mixture suitable for motor bearings for trolley cars?

Answer:—The accompanying table of babbitt mixtures will afford a wide range of selection. Generally, the tin alloys are used for motor bearings and they will withstand the pounding which crushes the lead anti-friction metals. No. 9 is a mixture quite largely used. It is a hard metal with a high melting point, which causes it to run sluggish if not heated to a high temperature. On this account many prefer an alloy containing less copper, as for instance, Nos. 1 and 2. No. 3 is an excellent alloy, and as it contains 25 per cent of

lead, is considerably cheaper than all the tin mixtures, and if there is no prejudice in favor of the latter alloys, I would strongly recommend this mixture.—K. K.

FORMULAS FOR BEARING METALS.

Description.	Tin, per cent.	Antimony, per cent.	Lead, per cent.	Copper, per cent.	Other constituents, per cent.
No. 1 Genuine babbitt for heavy service	89.	8.	0	3	0
No. 2 A. C. No. 1, Calumet and Hecla	83.5	11	0	5.5	0
No. 3 A. C. No. 2, standard for heavy work	60.75	10.50	25	3.75	0
No. 4 For Metallic packing, Prussian State Railways	53.3	5.	64.3	0.15	0
No. 5 Graphite bearing metal (no graphite)	15	17	68	0	0
No. 6 Pennsylvania Railroad standard bearing	0	13	87	0	0
No. 7 Magnolia metal	5	15	80	0	0
No. 8 Moore-Jones, armature babbitt	86.95	7.8	0	5	*0.25
No. 9 Pennsylvania Railroad No. 1	83.33	8.33	0	8.33	0
No. 10 Motor bearing	83	12	0	5	0
No. 11 Standard genuine	90	7	0	3	0
No. 12 Hard genuine	88	4	0	8	0

*Iron.

A CAST IRON FLASK FOR MOLDING ORNAMENTAL LAMP POSTS.

By H. Cole Estep

For molding ornamental cast iron lamp posts, the Independent Foundry Co., Portland, Ore., has adopted a cast iron flask of original design. The cope and drag are each cast solid, the cross bars in the cope being cast integral with the body. The sides and ends of the cope and drag are 1⅛ inches thick, and in addition a stiffening flange, 2½ inches wide by 1⅛ inches thick, is cast around the top and bottom of each part of the flask. The cope bars are ⅝ inch thick, cast with dovetail notches around their inner periphery. These notches hold the cope sand firmly and decrease the number of gaggers and nails necessary.

The drag is 13 feet 9 inches in length, 12½ inches high, and 28 inches wide at one end, tapering to 17 inches at the other. The cope is 13 feet, 9 inches in length, 28 inches wide at one end, 17 inches wide at the other, 12 inches high at the wide end and 6 inches high at the narrow end.

The casting consists simply of a rectangular pedestal surmounted by a long shaft. The shaft and pedestal are cast in one piece in the flask under consideration. The pedestal occupies the large end of the flask, the tapering shaft extending to the small end. The metal is poured through a pouring basin built on the cope.

Instead of being pinned together in the ordinary fashion, the flask is hinged at the large end so that it opens and closes like a pair of shears. In practice, the drag is rammed up first, rolled over and struck off. The cope is then fitted to the drag by simply dropping the hinge pins into the open sockets, which are bolted to the drag. The cope is next rammed up. Then by means of the handles cast on each side of the small end of the cope, the power of the traveling crane hoist is used to rotate the cope about its hinged end. The open mold is then prepared for closing and the cope is again rotated in position with the crane hoist.

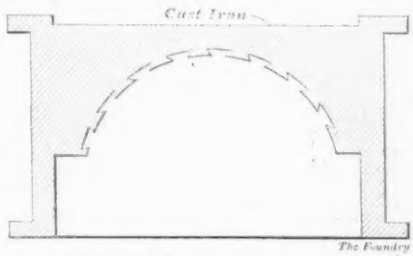


Fig. 2—Cross-Section of Cope Through a Cope Bar

The cope and drag each weigh 1,000 pounds, the total weight of the flask being about one ton. The cost of each flask is approximately $20. Once made they are indestructible. Three molders' helpers, using this style of flask, are able to make four complete molds in a nine-hour day. Plan view of the cope flask and side elevation of the closed flask, are shown in Fig. 1; a cross section through a cope bar of the cope flask is shown in Fig. 2, and the details of the flask hinge are illustrated in Fig. 3.

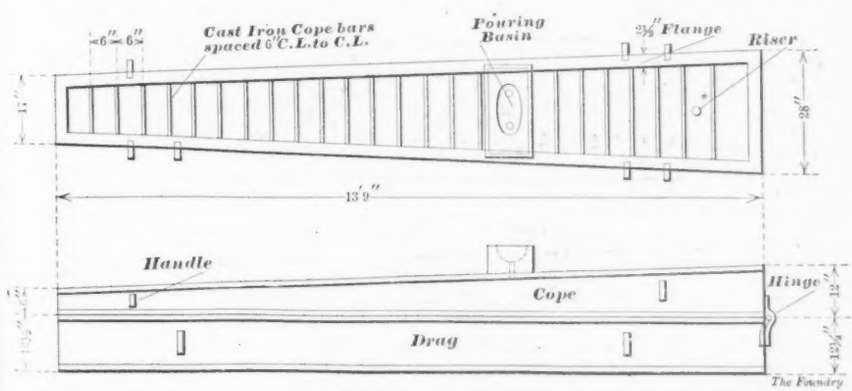


Fig. 1—Plan View and Side Elevation of Cast Iron Flask for Molding Lamp Posts

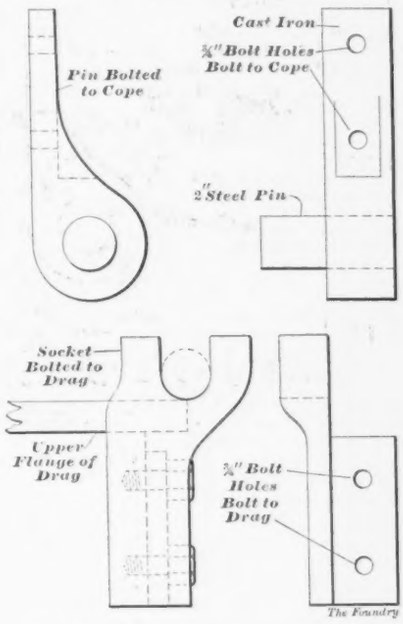


Fig. 3—Detail of Flask Hinge

J. W. PAXSON COMPANY TO OPEN NEW ENGLAND WAREHOUSE.

Wm. T. Nicholson, Providence, R. I., formerly associated with Cutter, Wood & Stevens, Boston, will represent the J. W. Paxson Co., Philadelphia, manufacturer of foundry supplies and equipment, in the New England states, for the sale of the complete Paxson line of foundry supplies, equipment and molding sands.

CONTINUOUS MELTING.

By W. J. Keep

Question:—What are the relative economies of melting 10 tons of iron as compared with 1½ tons of iron per hour in a cupola? Does the same melting ratio of coke to iron apply, and are the operating costs increased to any great extent with the low output as compared with a larger tonnage? We intend to melt continuously an output of 15 to 20 tons daily, and this would involve only a small tonnage per hour. Several practical foundrymen are of the

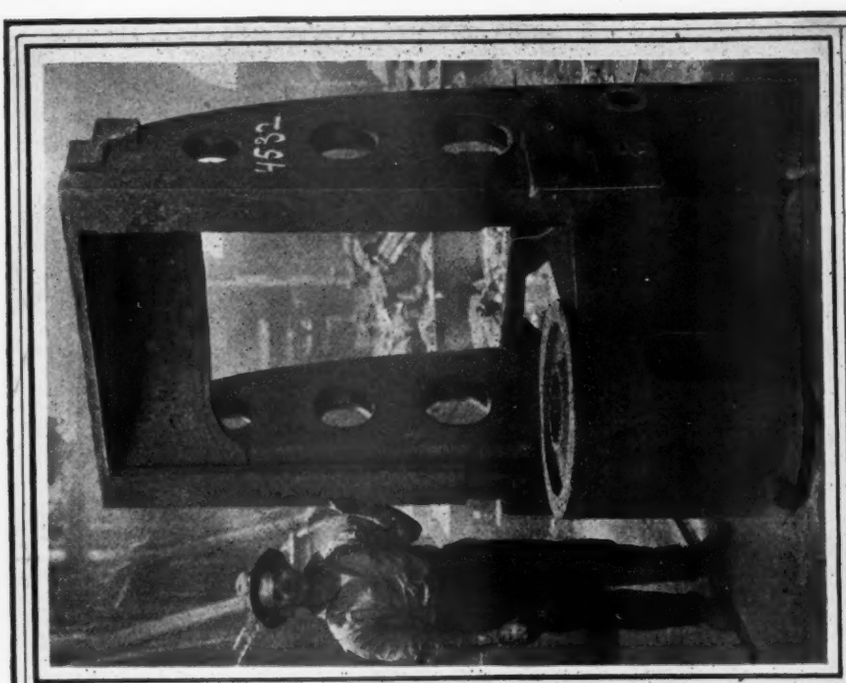


FIG. 3—A BORING MILL COLUMN; WEIGHT 4,532 POUNDS

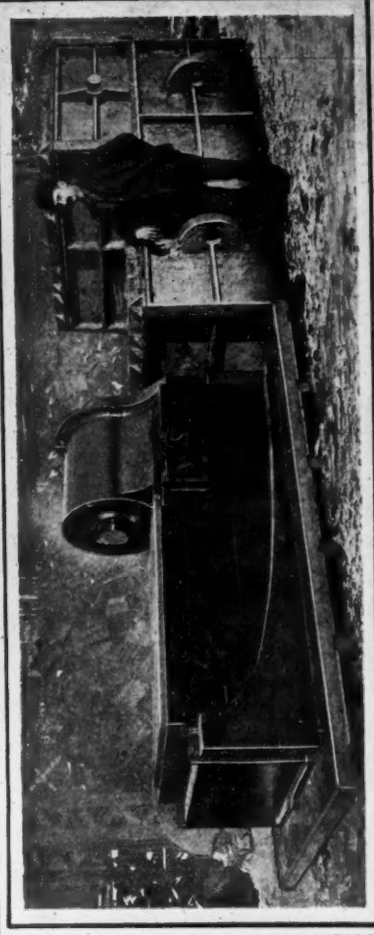
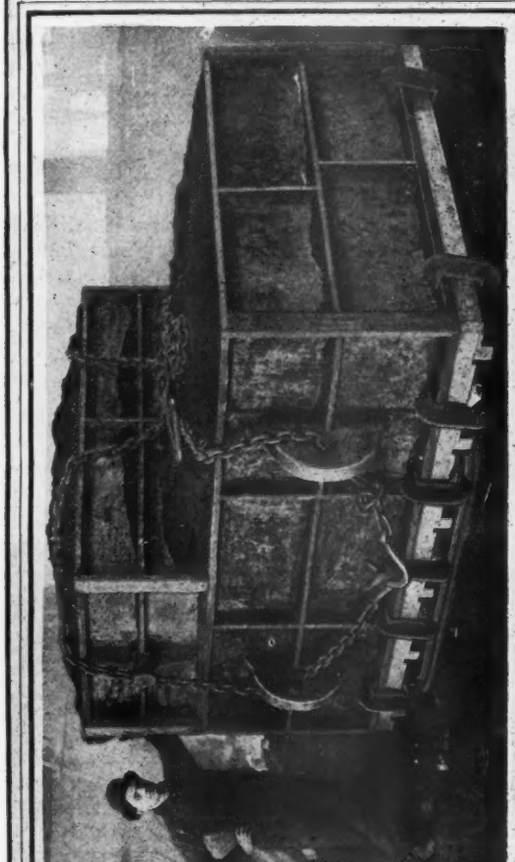


FIG. 4—THE PATTERN AND FLASK IN THE FOUNDRY YARD



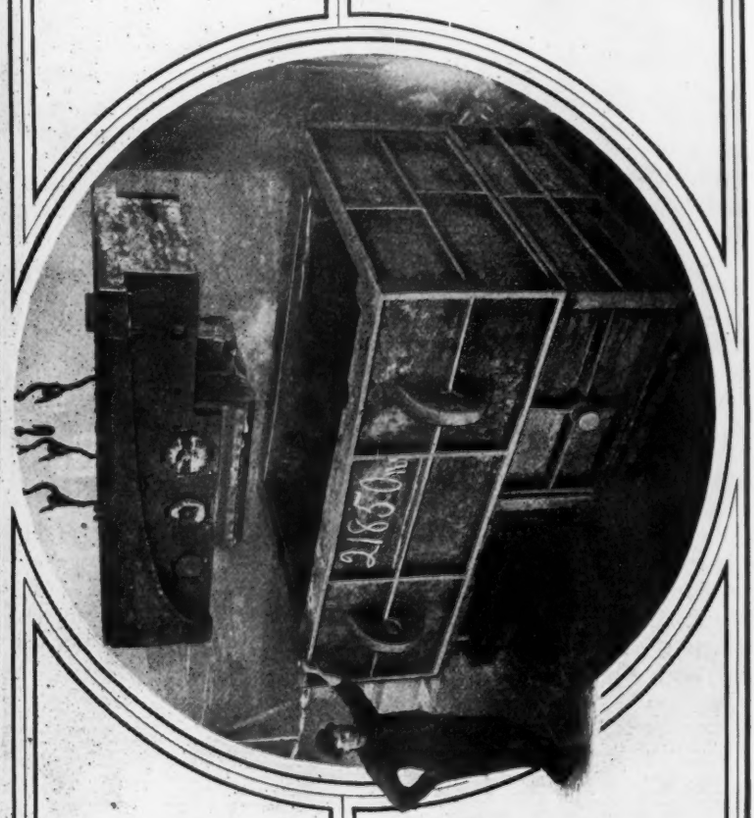


FIG. 1—FLASK ON THE JOLT RAMMING MACHINE TABLE
FIG. 2—DRAWING THE PATTERN

opinion that our melting in this way would not be on an economical basis.

Answer:—Melting 20 tons of iron at the rate of 10 tons per hour would require a cupola 72 inches in diameter, and a melting ratio, better than the average, would be 8½ to 1. This would require 2½ tons of coke and three men would be necessary on the charging floor. To melt two tons per hour would require a small cupola, about 30 inches in diameter, and it is doubtful if you could do better than 5 to 1 by continuous melting. You may be able to get along with two men, and perhaps only one. This continuous melting process would require 1½ tons of coke more than by fast melting, and at $4.75 per ton, the increased cost for fuel would be $7.12. Deducting from this one man's wages, the greater cost for melting continuously for this same tonnage would be $5.375. The greatest loss, however, would be otherwise incurred. It is difficult to keep a cupola free for more than three hours, especially a small one, and the slagging would require constant attention. The lining, with continuous melting, would not last nearly as long as with rapid melting, and it is my opinion that in this case the cost of continuous melting would be twice as much as when the same amount of iron is melted in two hours. Furthermore, when melting continuously, you would be obliged to have two cupolas, permitting the one to be repaired while the other is in operation.

If you are making bedstead or similar castings, you will be obliged to melt continuously, whatever the cost. With a cupola 5 feet in diameter, operating continuously day and night, the same as a Bessemer converter, the cupola must be kept free, and melting is economical, although the lining must be renewed every week. At the plant of the Henry R. Worthington Co., Harrison, N. J., the iron is melted continuously, and the hot sand from the molds is dropped through gratings into the basement, where it is cooled before it is used again. Cool sand is essential for good gray iron castings, and the only way that this can be accomplished in the ordinary foundry is to use it only once in 24 hours, permitting it to cool over night. From practical experience, the results would indicate that the greatest economies can be effected by melting rapidly the latter part of the day, although a greater floor space is required when this method is pursued.

MOLDING A LARGE BORING MILL COLUMN ON A JOLT RAMMING MACHINE

IN THE foundry of the Niles Tool Works Co., Hamilton, Ohio, molds for all kinds of large machine tool castings are now being rammed on jolt ramming molding machines. That it is possible and entirely feasible to make a mold in a flask of a larger size than the machine table, is shown in the accompanying illustrations. The machine on which this work was done has a 20-inch cylinder, 54 x 72-inch table, and has a capacity for making molds weighing from 12,000 to 15,000 pounds. It is of the Norcross type, and was built by the Arcade Mfg. Co., Freeport, Ill.

The flask on the machine table, shown in Fig. 1, is 9 feet 10 inches long and exceeds the greatest dimension of the table by 46 inches; the flask width, 6 feet 4 inches, exceeds that of the table by 22 inches, and at one end the flask is 6 feet 4 inches high. In Fig. 1 the outline of the table underneath the flask can be clearly seen, and it will be noted that a considerable portion of the pattern board extends beyond the table. The pattern molded in this flask is shown at the left, Fig. 4, and is a model of a large boring mill column, Fig 3, which weighs 4,532 pounds.

The pattern, which owing to its design and construction could not be drawn from the mold in one section, had a number of loose pieces, but the main part was drawn from the mold by a crane, as shown in Fig. 2. The mold weighed 21,850 pounds, and exceeded the capacity of the machine by more than 5,000 pounds. Under normal conditions this jolt-ramming machine will successfully ram molds at 75 to 80 pounds air pressure, but owing to the excessive weight of this mold, 95 pounds was required.

In addition to the mold, the large cores which it contained were also molded on this machine. Heretofore this column was made in a pit and was a very complicated job. The large cast iron flask in which this pattern was molded, in the foundry yards, is shown at the right, Fig. 4. The bottom boards are cast iron, and these are shown on top of the flask.

Fig. 1—Flask on the Jolt Ramming Machine Table
Fig. 2—Drawing the Pattern
Fig. 3—A Boring Mill Column
Fig. 4—The Pattern and Flask in the Foundry Yard

PHILADELPHIA FOUNDRYMEN ELECT OFFICERS.

At the annual meeting of the Philadelphia Foundrymen's Association, held Wednesday evening, Jan. 5, officers for the ensuing year were elected as follows: Thos. Devlin, president; E. E. Brown, vice president; J. Thompson, treasurer; Howard Evans, secretary. Executive committee: Walter Wood, chairman; H. L. Haldeman, Thos. Eynon, Walter McDonald and S. S. Knight. Geo. C. Davis was re-elected chemist of the association.

MIXTURES FOR DIE-MOLDED CASTINGS.

Question:—Can you give us brass and white metal mixtures for die-molded castings?

Answer:—So far as we can ascertain, there is only one concern making brass castings in dies, the other die casting manufacturers using white metal mixtures. The mixture used for brass die castings is a yellow brass, high in zinc. Of the white metals, Parson's white brass is largely used for bearings. Its composition follows: Tin, 56.46 per cent; zinc, 38.6 per cent; copper, 2.15 per cent; antimony, 1.54 per cent; lead, 0.63 per cent; iron and aluminum, 0.6 per cent. The iron and lead may be considered as impurities carried by the other metals, but the aluminum is necessary to give fluidity to the alloy. Lumen bronze is also cast in dies. Its formula follows: Zinc, 86 per cent; copper, 10 per cent; aluminum, 4 per cent. Another alloy with a zinc base contains: Zinc, 93 per cent; copper, 2 per cent; tin, 3½ per cent; antimony, 1½ per cent, and aluminum, 1 ounce.

White metals with a lead base that are die-cast, follow: Antimonial lead (lead 80 per cent, antimony 20 per cent) 80 per cent, antimony 10 per cent and tin 10 per cent, also lead, 80 per cent; antimony, 15 per cent, and tin, 5 per cent.—K. K.

Howard C. Matlack, formerly connected with Frank Samuel, Philadelphia, has associated himself with G. Walter Bates, of Wilson & Bates, bar iron merchants, Philadelphia. The firm name of the new concern is Matlack & Bates, and the office is located in the Pennsylvania building, room 1119. This company will engage in the sale of pig iron and coke.

THE FOUNDRY

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North Pacific Foundry Trade

Quietness has characterized the foundry trade of the north Pacific coast during the past four weeks. In fact, if it were not for the activity of the shops attached to manufacturing plants and the car wheel foundries, the trade would be extremely dull. The jobbing business is very light and several prominent jobbing shops are all but shut down. Floods and freight congestion, coupled with a general apathy on the part of the buyers of castings, have combined to depress business among plants doing general work. Jobbing prices for castings have failed to rise in response to the increased cost of raw materials. Two cents a pound is freely quoted for building castings on Puget sound and many machinery castings are being sold for figures varying between 3 and 3¼ cents. Building castings in Spokane are 2¼ cents a pound.

The following estimate of the cost of making building castings on the north Pacific coast at present was made by a prominent foundryman, assuming that the pig iron was purchased six months ago for January delivery at the prices then prevailing. Price per ton of building castings, columns, column footings, etc.:

Pig iron, 0.6 ton at $21.00, ...	$12.60
Scrap steel, 0.4 ton at $7.00, ...	2.80
Coke, 1/6 ton at $7.20, ...	1.20
Labor, ¼c. per pound	5.00
Fixed charges	12.00
Total, ...	$33.60

There is a large amount of building work under consideration at the present time, but very few contracts are being let. It is conceded in all quarters that the present prices of castings are disproportionately low and an advance is expected to characterize the first half of the new year.

PERSONAL.

The Standard Sand & Machine Co., Cleveland, announces the appointment of T. J. Morgan to the position formerly occupied by W. H. Smith, sand salesman, who recently resigned.

F. A. Hall, for the past 12 years manager of the chain block and hoist department of the Yale & Towne Mfg. Co., New York City, has resigned to accept the position of vice president and treasurer of the Cameron Engineering Co., Brooklyn, N. Y. Mr. Hall's successor will be R. T. Hodgkins, who for several years has been Mr. Hall's chief assistant. In his new connection, Mr. Hall expects to make a specialty of trolleys and appliances for overhead handling of materials, and in connection therewith to make use of the Yale & Towne blocks and hoists.

J. Kent Smith, who returned to Europe last year, after spending two years in the United States in the interest of vanadium steels, has been elected a director of the International Vanadium Co., Ltd., with works at Garston, Liverpool.

William H. Wilson, analytical and consulting chemist, has established a laboratory at 138 East Seventy-third street, New York City. Mr. Wilson will make a specialty of analyses of foundry and iron works supplies.

George Walworth Hayden has been appointed general plant manager and superintendent of the works of the Pratt & Cady Co., Hartford, Conn. Mr. Hayden was for 19 years connected with the Crane Co., Chicago, and during the past year was employed as works manager by the McNab & Harlin Co., Newark, N. J.

James M. Creamer has been placed in charge of the publicity and advertising department of the International Steam Pump Co., New York City.

M. L. Johnson, who has been in charge of the order department of the Sharon, Pa., plant of the American Steel Foundries, Chicago, has been promoted to the position of assistant manager.

Willis Collins, who was connected with the Allis-Chalmers Co., Milwaukee, for 14 years, has been elected secretary of the Sivyer Steel Casting Co., Milwaukee, and will be placed in charge of the manufacturing department. Mr. Messinger, who has been secretary, has been elected vice president and manager in charge of sales.

Chas. F. Ladwig has been appointed superintendent of the gray iron foundry, operated by the McCall Mfg. Co., Macon, Mo.

Wm. Mayer is now associated with the DeSota Foundry & Machine Co., Ltd., Mansfield, La. This concern recently installed a steel converter.

J. W. Coyle, formerly associated with the Best American Calorific Co., is now associated with the Rockwell Furnace Co., 26 Cortlandt street, New York City, and is making a specialty of oil and gas furnaces for railroad work. Mr. Coyle was formerly master blacksmith in the Lehigh valley shops, Wilkesbarre, Pa., and was later in charge of the hammer and machine department of the forge shops of the Reading railroad, Reading, Pa.

MODERN EQUIPMENT FOR THE FOUNDRY

Drop plate and stripping plate molding machine --- High pressure sand blast --- Turbine-driven gas and cupola blowers --- Casting brush

A DROP plate and stripping plate molding machine, built by the J. D. Smith Foundry Supply Co., Cleveland, is shown in the accompanying illustrations. In Figs. 1 and 2 it is used as a drop plate machine, the pattern plate upon which the pattern is mounted being dropped away from the mold. The pattern is a model of a part of an armature spider, and in Fig. 1 the pattern plate is elevated in position for ramming the mold. In Fig. 2 the mold has been rammed, lifted off, and the pattern plate is in its lowered position. The machine is simple in design and rigid in construction. The main frame is cast iron with a flaring, substantial base. This base insures the rigidity of the machine while the operator is ramming the mold.

The two steel plates on top of the side frames slide in and out, and are adjustable to varying widths of pattern plates up to 16 inches, the capacity of the machine. This adjustment of the top plates to pattern plates of various sizes, is an important feature, and obviates the necessity of making special pattern plates for machine use. The pattern plate is attached to a carriage, which has a drop of 10 inches, and which slides in V-ways machined in the frame side pieces. The pattern plate is lowered and raised by a forged steel hand lever, and one-half revolution of the gears gives the maximum drop of the carriage. The two gears actuating the carriage are machine-cut, crucible steel castings. The upper gear is attached to the lower adjusting bar of the carriage, and the lower gear is attached to the main shaft, which is operated by the lever. The two gears are connected by two crucible steel plates. The guides for the carriage are of sufficient length to insure the accurate up and down movement of the pattern plate. The side frames of the carriage are held together by three pieces of cold-rolled steel shafting, fastened with adjusting nuts to take up wear.

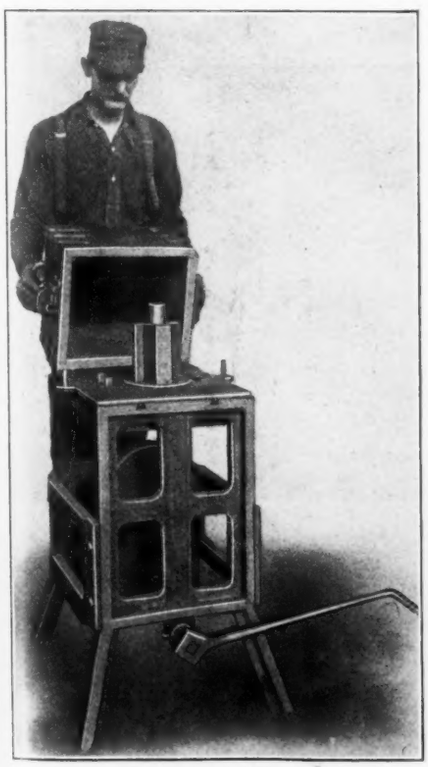


FIG. 1—DROP PLATE AND STRIPPING PLATE MACHINE WITH PATTERN IN RAMMING POSITION

The operation of the machine as a stripping plate molding machine is illustrated in Figs. 3, 4, 5 and 6. The top plates on the side frames have been removed, this operation being accomplished in an instant. The pattern is a slide rail for motors, and the wood stripping plate is 48 inches long. The pattern is attached to the carriage with screws, while the stripping plate is hinged to the frame of the machine. In Fig. 3 the stripping plate is on the machine, the pattern is raised, and the operators are preparing to place the drag flask in position for ramming the mold. The cope half of the mold is rammed on a stand, shown in front of the machine, and in the foreground is a mold ready for clamping.

In Fig. 5 the operator is ramming the drag, and in Fig. 4 the bottom board has been adjusted, the pattern has been lowered away from the mold, and the stripping plate is clamped to the flask before rolling over. In Fig. 6 the drag has been rolled over onto the stand on which the cope was previously rammed, the clamps have been removed, and the stripping plate is being swung back on its hinges preparatory to ramming another mold. The advantage of rolling over the stripping plate with the flask is in the protection of the edges of the mold at the parting line when the blacking is being applied. The stripping plate may also be attached by bolts or screws to the side frames, and the flask is then lifted off as on an ordinary stripping plate machine. The cope half of the mold is shown in the foreground, Fig. 6. The flasks are located on the stripping plate by loose pins, which pass through ears on the flask into the stripping plate.

The High Grade Metal Co., Brooklyn, N. Y., has been organized to engage in the production of castings made from a new alloy, which is styled as "Milnerite." This is an alloy with a specific gravity of 3.10 and weighs about 1¾ ounces per cubic inch. It has a tensile strength of from 35,000 to 45,000 pounds per

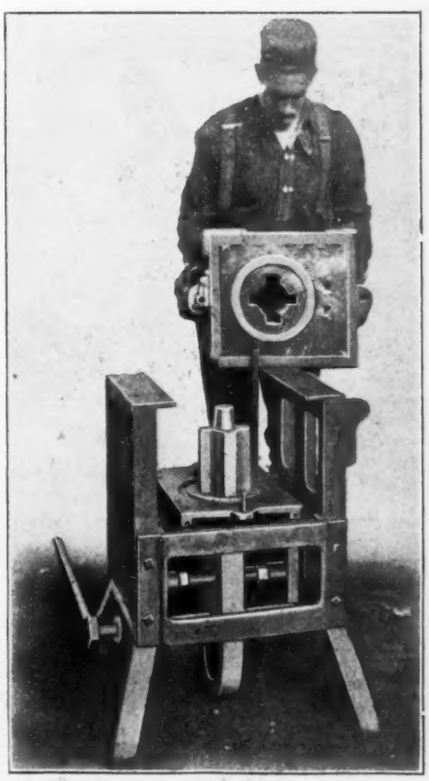


FIG. 2—PATTERN PLATE AND PATTERN DROPPED AWAY FROM THE MOLD

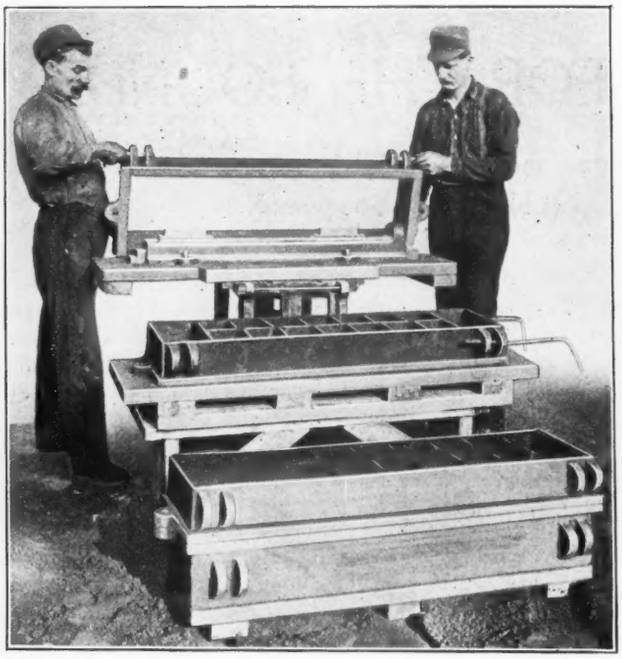


FIG. 3—DROP PLATE AND STRIPPING PLATE MACHINE PROVIDED WITH A STRIPPING PLATE, 48 INCHES LONG

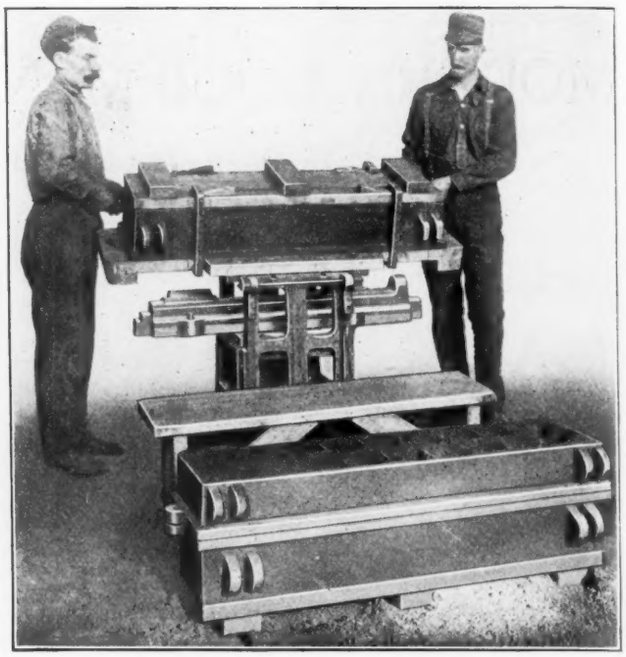


FIG. 4—PATTERN DROPPED AWAY FROM THE MOLD WHICH IS CLAMPED AND READY TO ROLL OVER

square inch, and can be produced as a fairly soft, ductile metal, or as a strong, hard metal. This concern is well equipped, and can make prompt shipments of castings of any size. According to weight, the prices of these castings are about the same as are quoted for brass, inasmuch as this metal weighs about one-third as heavy as brass or bronze.

YARDVILLE SAND COMPANY.

The Yardville Sand Co. has begun operations on a large acreage at Yardville, N. J., about 6 miles east of Trenton, on the main line of the Amboy division of the Pennsylvania Railroad. Its property at this point is underlaid by deposits of concrete sand of unknown depth and contracts have been closed for its use in several railway and building operations in that district. Sidings and switches have been constructed and the plant now includes a work house and a tool house and a large reservoir with pumps. Loading with the steam shovel now in place, the operation is capable of shipping 60 cars per day. A screening plant will be put in shortly. A good part of this acreage is underlaid with

FIG. 5—RAMMING THE DRAG ON THE MACHINE. THE COPE WAS MADE ON THE STAND IN THE FOREGROUND

FIG. 6—ROLLING BACK THE HINGED STRIPPING PLATE PREPARATORY TO MAKING ANOTHER MOLD

a 3 to 4-foot vein of molding sand, which has been pronounced by foundrymen to be of standard quality. In places this is overlaid in only a foot of soil, and arrangements for its mining on an extensive scale have been made. James M. Seabury is president of the company, and B. P. Kimble is superintendent.

THE PANGBORN HIGH PRESSURE SAND BLAST.

A high pressure sand blast equipped with an air separator, which extracts all moisture and oil from the compressed air before it comes in contact with the sand, built by the Thomas W. Pangborn Co., 90 West street, New York City, is shown in Fig. 1. It is adapted for cleaning gray iron, malleable, steel, brass and aluminum castings, as well as for the removal of scale, paint, rust, discoloration, etc., from all metals, and for preparing surfaces for painting, plating, galvanizing, japanning, enameling, etc. For cleaning gray iron and malleable castings, an air pressure of at least 80 pounds at the sand blast is desirable; for brass and aluminum it should not be lower than 60 pounds, and for steel castings, which are more difficult to clean, the air pressure should not be less than 90 pounds.

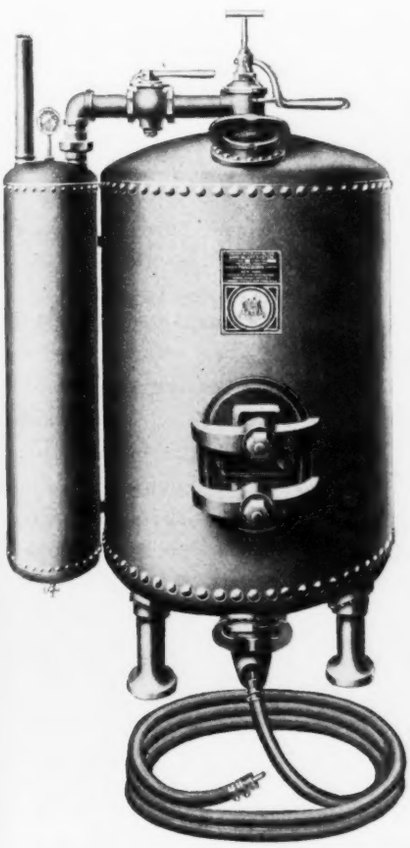


FIG. 1—THE PANGBORN HIGH PRESSURE SAND BLAST

This equipment is heavily constructed throughout, and has been designed with the greatest dimensions at the wearing points. The body of the sand chamber is steel boiler plate, ⅜ inch thick, and the head and bottom are

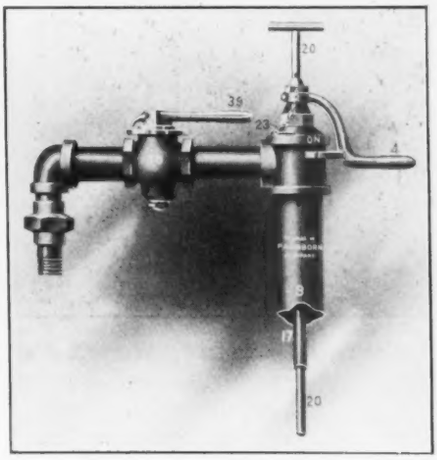


FIG. 2—AIR AND SAND CONTROLLING LEVERS OF HIGH PRESSURE SAND BLAST

of the same material, about ½ inch thick. This construction makes possible the use, with safety, of any pressure up to 150 pounds.

In operation, the compressed air after passing through the moisture and oil separator, Fig. 1, is carried to the air regulator, *38*, Fig. 2, which has a graduated dial directly under the indicator point of the handle, *39*.

The volume of air is "on full" with the indicator at either end of the quadrant. When the indicator is at the center of the quadrant the regulator is closed. The air may be regulated to any desired volume between these points in either direction, as desired by the operator. From the regulator the air is transmitted to and through cylinder *9*, Figs. 2 and 3. The ports in the top of the cylinder, one of which is shown, deliver the air to the sand chamber to maintain equal pressure above the sand, and to aid in insuring a uniform flow. The sand controller handle, *4*, which is securely fastened to the piston shaft, *17*, Fig. 2, moves on a quadrant having limit stops for its "off" and "on full" positions. To insure the permanency of its position when set at the desired point between these limits, there is enclosed in the handle a plunger backed by a spring, which gives sufficient friction to maintain the position. By its handle, the piston is rotated in its casing, opening, regulating and closing the sand ports by a single control. This construction, togther with the rotary piston valve action, makes absolute the maintenance of a uniform flow of sand, as the possibility of chance variation of the controlling mechanism is entirely eliminated. The stirring rod and its handle, *20*, connect with a fork, which operates inside of the piston and mixing chamber for dislodging caked sand that may form under certain conditions. This rod is held in its uppermost position by a clamp, when not in use, thus obviating the necessity of taking apart the section of the apparatus shown in Fig. 3.

The mechanism, governing the volume of sand flow, the method of mixing the sand and air, and the transmission of the sand to the hose, is shown in cross-section in Fig. 3. Ports, elliptical in form, are located in opposite sides of both the piston casing, *13*, and the piston, *16*. These are inclined downward, thus starting the sand flow by gravity. The rotation of the piston inside of the casing by the piston shaft *17*, which is connected to the sand controller handle, gives the desired opening up to the full size of the ports. The air is carried from the cylinder *9*, through the air ports in the piston, engages the entering sand and flows through the sand ports in two streams, crossing each other from opposite sides, into the mixing chamber, *19*. By this cross flow a swirling motion is produced, and a thorough mixture of the sand and air is insured.

This mixture, which is carried forward under high pressure by the design of the mixing chamber, is com-

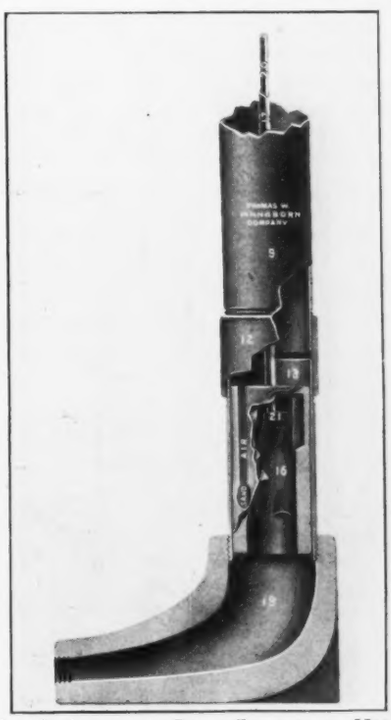


FIG. 3—INTERNAL SAND CONTROL OF HIGH PRESSURE SAND BLAST, INCLUDING MIXING MECHANISM, MIXING CHAMBER AND STIRRING FORK

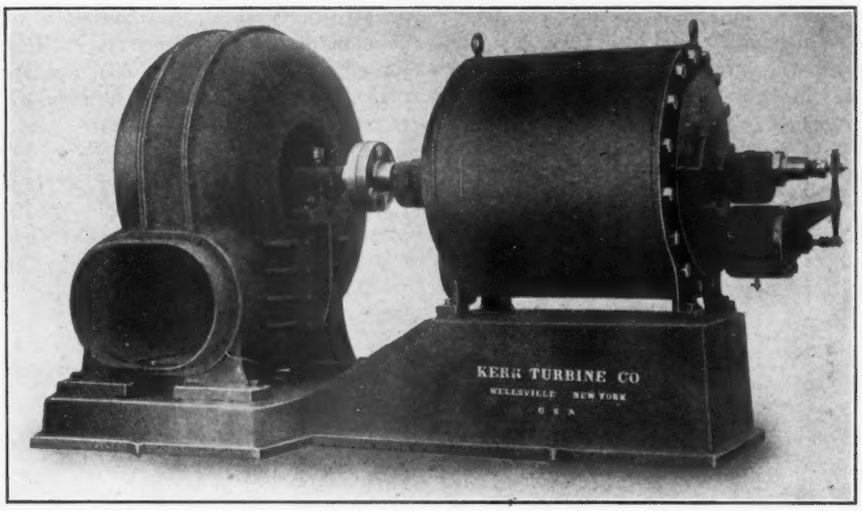


FIG. 1—KERR STEAM TURBINE COUPLED DIRECT TO A STURTEVANT WIDE MOUTH BLOWER

pressed through an area, which is gradually reduced from 2½ inches in diameter at the entrance to ¾ inch at the hose connection. By this constant reduction an increase of velocity is obtained, which is still further accentuated by the area reduction at the nozzle, until at delivery a terrific velocity is obtained.

The Pangborn sand blast systems are built in 12 sizes, with sand capacities varying from 500 to 10,000 pounds.

TURBINE-DRIVEN GAS AND CUPOLA BLOWERS.

By C. V. Kerr

Until recently, the accepted way of providing blast for the generators in gas works and for cupolas in foundries, was to drive the high pressure, high speed blowers by means of belts from high speed steam engines. The varying tension and condition of belting necessarily made such a drive more or less unreliable. Belts were broken, or would slip and the capacity of the generators was affected according to what happened at the blower.

In Fig. 1 is an illustration of a typical modern gas or cupola blower made extra heavy for long and continued service, driven by a steam turbine at a speed required by the desired pressure. This particular steam turbine is of the nozzle and bucket, or impulse type, following the Pelton system of using water under high pressure in double cup buckets with a construction of casing, nozzle and bucket adapted to the use of steam. The shell of the turbine is made of circular sections, made steam tight at the joints by fiber packing backed by metal to metal joints, which prove extremely useful in service. This construction permits rapid taking down of the turbine when necessary to do so and also gets rid almost entirely of troubles due to heating of the parts of the turbine by steam.

The bearings are of the ring-oiling type and on account of heat being transmitted to the bearings by radiation, along the shaft and to heat developed in the bearing itself by friction, cylinder oil is used for lubrication. Such an oil will run indefinitely at a temperature as high as 200 degrees Fahr. with perfect safety as it has a lubricating range of at least 400 degrees Fahr.

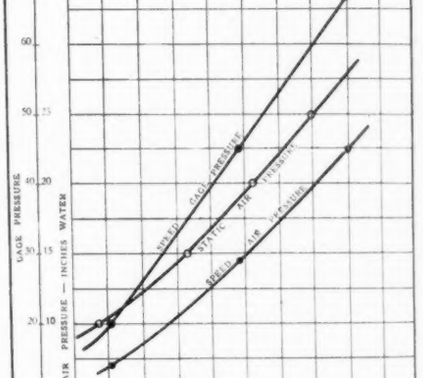


FIG. 3—CURVES PLOTTED FROM DATA OBTAINED FROM THE TEST MADE OF A TURBINE AND BLOWER UNIT

The governor of the turbine is of the centrifugal type and the weights are made semi-circular on account of the small diameter required by the high speed of rotation. The movement of the weights is transmitted through a rolling contact to the valve stem through the lever shown. The valve itself is of the double beat, poppet type and controls the speed of the turbine by throttling the steam. The speed of the blower depending on the air pressure desired, may be varied several hundred revolutions by simply adjusting the tension of the governor spring.

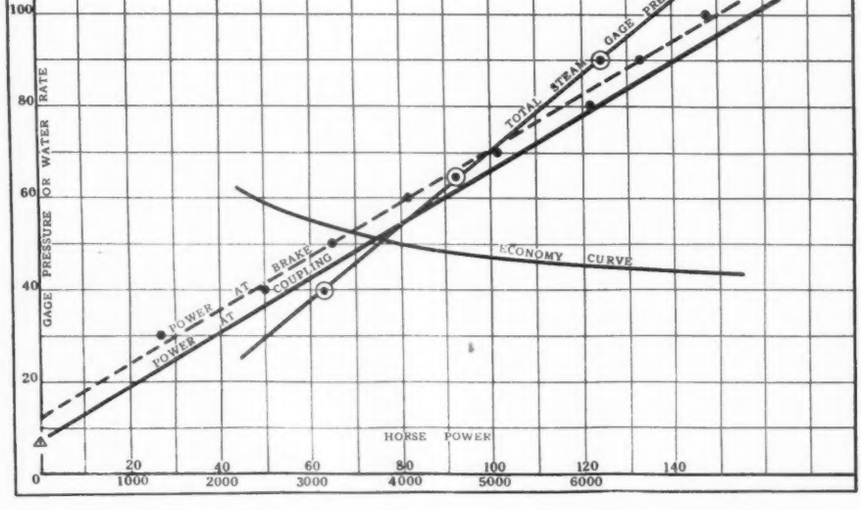


FIG. 2—DIAGRAM SHOWING RESULTS OF TESTS OF A KERR STEAM TURBINE

Shown in Fig. 1 is a 24-inch Kerr steam turbine, rated at 130 brake horsepower at a speed of 2,100 revolutions per minute. The initial steam pressure is 100 pounds and the exhaust, atmospheric. Under the conditions stated above the steam per brake horsepower hour was guaranteed at 44 to 45 pounds.

All of the turbines built by the Kerr Turbine Co. are tested under as near actual operating conditions as possible before shipment. A brake is used to grip the brake pulley with internal flanges. The stream of water is thrown into each end of this pulley and the water under centrifugal force passes out through the holes drilled in the rim of the pulley on to the working surface of the brake, where the friction heat is developed. This construction has given very high absorptive power for this type of brake with a high surface speed and steady running.

On the curve shown in the diagram in Fig. 2 the dots on the line called "Power at Brake," show results from the test on this particular turbine. To eliminate the losses in the brake itself due to bearing friction and vibration, the turbine is run at rated speed with the coupling disconnected. The pressure required to do this is shown at the point surrounded by a triangle. Through this point a line called "Power at Coupling" is drawn parallel to the line of "Power at Brake." In connection with these tests, a calibrated steam gage is connected to the steam chest of the turbine just below the governor valve. The pressures found there are indicated by the ordinates on the diagram in Fig. 2, showing gage pressure. From the curve of "Power at Coupling" the horsepower transmitted through the coupling, for any given steam pressure fixed by the governor, can be ascertained.

It has been found in practice that the steam flow through the turbine is the same whether standing or running. For convenience in testing, the steam flow through the turbine is determined with the turbine held still by the brake. The results of such steam flow test for three different points are shown in the curve called "Total Steam-Gage Pressure." From the two curves thus determined, the economy curve is calculated. To use the exact figures from the test, with an initial pressure of 90 pounds in the steam chest and atmospheric back pressure, the turbine developed 140 brake horsepower at 2,003 revolutions per minute with an actual water rate uncorrected for moisture of 44 pounds per brake horsepower hour. In the turbine, such a water rate will be maintained indefinitely, as it is not liable to loss of power through leakage past pistons and valves as in the case of the steam engine.

Unlike the steam engine again, the steam turbine has its best speed higher than that of even the pressure blower. To meet this condition the B. F. Sturtevant Co., Hyde Park, Mass., has brought out a specially designed form of blower called the "Turbine Type." It is distinctive as shown in Fig. 1, as it has an oval mouth in place of the usual circular one. This construction permits making the wheel or runner wider for a given diameter and therefore secures a higher rotative speed for the same capacity in air per minute. In this case the blower was rated at 16,000 cubic feet of air per minute against 14 ounce pressure or 24-inch water gage.

In Fig. 3, are shown curves plotted from data obtained on the test made of the complete unit. This shows the relation between speed gage pressure and air pressure and will require no explanation. The blower discharged air through a nozzle 4 feet long, tapered from the full size of the mouth of the blower to an orifice 12.75 inches in diameter. The area of the mouth of the blower is 2.76 square feet while the nozzle area is 0.886 square feet. The ratio of nozzle to mouth area is 0.32. In this case the air pressure was measured at the mouth of the turbine and from it the volumes shown in the curve giving relation of static air pressure to volume were calculated. At 24-inch water pressure, equal to 14 ounce pressure, the volume discharged is seen to be well above the rated capacity. In this case, as a matter of fact, the calculations did not show the full discharge, as no account was taken of the velocity through the mouth of the blower. The relatively small amount of power required by the blower at rated capacity is shown by the fact that only 67 pounds steam chest pressure was required to drive the blower at a speed giving 22½-inch water gage pressure. A large reserve power in the turbine and capacity in the blower is thus shown by the tests made on the unit.

These units can be furnished for cupola service, by the Kerr Turbine Co., Wellsville, N. Y., in varying capacities. For a 36-inch cupola, a 10-ounce pressure can be provided at a speed of about 3,500 revolutions per minute. For an 84-inch cupola, a 14-ounce pressure can be provided at a speed of 2,500 revolutions per minute.

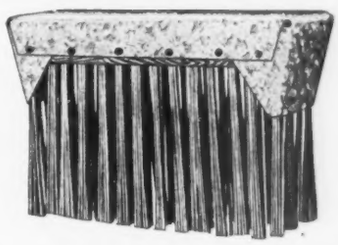


FIG. 1—THE SHANAFELT CASTING BRUSH

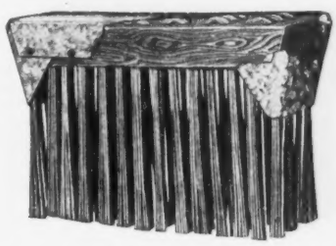


FIG. 2—CASTING BRUSH WITH SECTION OF GALVANIZED STEEL TOP BROKEN AWAY

THE SHANAFELT CASTING BRUSH.

The casting brush shown in Figs. 1 and 2, made by the Shanafelt Mfg. Co., 1228 West Ninth street, Canton, Ohio, is so constructed that it is impossible to force up the bristles or to raise the back of the brush, regardless of the use to which it may be subjected. As shown in Fig. 1, the brush has a round-edged galvanized steel back, and briddled ends, which are fastened with nails on the sides, thereby eliminating the possibility of raising the back of the brush. A view of the brush with a section of the galvanized steel top and side removed, is shown in Fig. 2. These brushes are made in two sizes, the wire bristles being 4 inches long, block 7½ x 2½ inches, and with either four or five rows of wire.

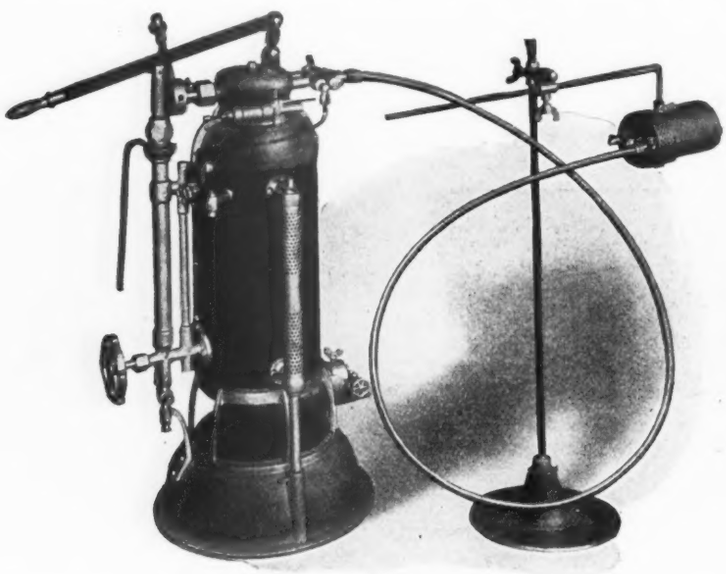
FOUNDRY EQUIPMENT EXHIBIT AT DETROIT.

C. E. Hoyt, secretary of the Foundry and Manufacturers' Supply Association, in an announcement recently issued to the members of this organization, states that from present indications more than twice the space used at previous conventions will be required for the exhibits that will be made in Detroit during the week of June 6 to 10. The invitation from Detroit conveys the privilege for exhibition purposes of the grounds and buildings of the Michigan State Fair

Association, and a contribution of $1,200 toward defraying the expense of temporary buildings has also been made by Detroit foundrymen. All permanent buildings have concrete floors on the ground level, and exhibits requiring foundations and pits will be placed in a temporary building. The Cadillac Hotel has been chosen as headquarters for the Foundry and Manufacturers' Supply Association.

THE VOLCANO BLOW-TORCH.

The gasoline blow-torch shown in the accompanying illustration, sold by the Manufacturers' Supply House, 1012 State street, Erie, Pa., is adapted for heating defective castings, which are to be patched, plugged, or on which missing parts are to be brazed. It can also be used for releasing or making shrinkage fits on heavy machinery or engines,



VOLCANO GASOLINE BLOW-TORCH

for brazing iron or copper tubing, for straightening steel sections, etc. This torch dispenses with the air pump, and the gas is generated by an auxiliary burner located at the bottom of the cylinder, this burner being fed from the compressed gas of the torch by copper tubing leading to the main valve on top of the cylinder. The gasoline is pumped into the torch by the top lever, and the pressure is regulated by the collar, which operates the valve enclosed in the top of the torch. The torch is so constructed that it can be refilled without suspending operations. The tank of the torch is a steel cylinder capable of sustaining a pressure of 2,000 pounds per square inch, and is provided with a safety valve. It can be operated between 10 and 200 pounds pressure, and can be maintained at working pressure of 80 to 140 pounds without the use of an air pump. The gasoline is converted into gas before leaving the cylinder, thereby insuring perfect combustion in the burners and a high degree of heat. The torch shown is provided with an extension burner, ¼ inch seamless copper tubing being used for delivering the gas to the torch. The Manufacturers' Supply House is also engaged in the mining and shipping of all kinds of molding sand, its Empire brand, which is mined in western New York, being well adapted for brass, aluminum and fine gray iron work.

LARGE SAND FLEET.

A large fleet of boats is engaged in the shipment of molding sand on the Atlantic coast, the Whitehead Bros. Co., Providence, R. I., having no less than 50 schooners and barges employed in the shipment of sand from its own banks. This sand is delivered by boat to points along the Hudson river, as far south as Baltimore and east to Belfast, Maine. Shortly before the closing of the shipping season last November, the Whitehead Bros. Co. had 21 boats delivering sand at one point in Connecticut. The combined tonnage of the Whitehead fleet is 25,000 tons, and the largest boat is rated at 1,200 tons.

TRADE NOTES.

The Northern Engineering Works, Detroit, builders of cranes and hoists, have purchased additional land adjoining their plant, on which they will probably make extensions to their crane department.

The Bruce-Macbeth Engine Co., Cleveland, builder of two and four-cylinder gas engines, has opened a branch office in Philadelphia, at 1020 Drexel building. It is in charge of M. E. Jackson.

The Superior Sand Co., 503 Cuyahoga building, Cleveland, has been organized to engage in the mining and shipping of Zanesville, Conneaut and Tuscarawas, O., molding sands. Walter T. Findley has been elected president; W. H. Smith, vice president and general manager, and H. C. Koontz, secretary and treasurer. Mr. Smith has had 12 years experience in the molding sand business, and during the past six or seven years has been associated with the Standard Sand & Machine Co., Cleveland, while H. C. Koontz has been connected with the Interstate Sand Co., Cleveland, during the past five years.

At a recent meeting of the stockholders of the H. E. Mills Mfg. Co., Syracuse, N. Y., officers were elected as follows: President and treasurer, H. E. Mills; vice president and general manager, L. D. Douglas; secretary, Frank T. Mills. The officers together with N. H. Childs and W. H. McIlravy comprise the board of directors. It was decided to immediately begin the erection of a plant at Solvay, N. Y. This concern manufactures dry core compounds and liquid core binders of all kinds.

The Q. M. S. Co. (Quincy, Manchester, Sargent) New York City, announces that after Jan. 1 its western office will be at 738 First National Bank building, in charge of John C. Hoff.

The Robeson Process Co., Au Sable Forks, N. Y., has moved its New York office from 1777 Broadway to 39 Cortlandt street. The main office is still located at Au Sable Forks, where all communications intended for the company should be addressed.

The Detroit Foundry Supply Co., Detroit, is sending to the trade a calendar, which is especially adapted for office use, owing to the large size of the pad containing the months of the year.

The Arcade Mfg. Co., Freeport, Ill., manufacturer of molding machines, has issued a 16-page booklet giving a list of its molding machine installations. This is an impressive list, inasmuch as in one foundry 27 machines are installed, in another 22, others 15, etc.

The Rogers-Brown Iron Co., Buffalo, has been organized with a capital of $5,000,000, and will take over the Buffalo and Susquehanna Iron Co., which now operates two blast furnaces in Buffalo. The newly incorporated concern will erect two blast

furnaces on a site adjoining the plant of the Buffalo & Susquehanna Iron Co. All of the ore properties of the Buffalo & Susquehanna Iron Co. in Michigan and Minnesota, as well as the coal mines and coking properties in Pennsylvania, will be taken over by the new company.

The Bayonne Casting Co., Bayonne, N. J., announces that it is now making castings of Monel metal, including such sections as propeller wheels, marine fittings, acid-handling apparatus, exhaust fans for acid gases, pumps, plungers, pickling apparatus, etc. The shrinkage of this metal is ¼ inch per foot, and it has a tensile strength varying from 73,283 to 81,609 pounds per square inch. The elongation in 2 inches varies from 38 to 28½ per cent. The specific gravity of cast Monel metal is 8.87.

The J. F. Webb Mfg. Co., Davenport, Iowa, in a four-page pamphlet recently issued, describes a portable, pneumatic, power-ramming molding machine. It is especially adapted for light work and is made in two sizes, for flasks 10 x 20 inches and 8 inches deep and 15 x 26 inches, and 8 inches deep.

GENERAL INDUSTRIAL NOTES

Edward Maher's Sons, iron founders, Newark, N. J., will erect a gray iron foundry on Berlin street, the main building of which will be 90 x 160 feet. It will be equipped with a 15-ton electric traveling crane, and the daily output is estimated at 30 tons. A pattern shop will be added, as well as sand blast apparatus and pneumatic tools for cleaning castings. A number of molding machines will also be installed. Wm. A. Maher and Frank R. Maher, who constitute the firm of Edward Maher's Sons, are the sons of the late Edward Maher, of the firm of Maher & Flockharts.

An addition is being erected to the foundry operated by the Harrison Machine Works, Belleville, Ill. The building will be 25 x 80 feet.

The Denver Brass Works, Denver, Colo., which was compelled to seek a new site on account of the condemnation of its present location for boulevard purposes, is erecting a new foundry, 30 x 132 feet, which will be equipped with all modern appliances.

The King Sewing Machine Co., Buffalo, has secured a site of eight acres upon which a plant costing approximately $150,000 will be erected. The foundry will be 150 x 300 feet; machine shop, 300 x 300 feet, and warehouse and office building, 800 x 200 feet.

The Milwaukee Stove Works, Milwaukee, Wis., will erect a new foundry, 110 x 270 feet.

The McCall Mfg. Co., Macon, Mo., manufacturer of farm implements, will erect a gray iron foundry for the manufacture of castings for its own use.

The Southern Steel Casting Co., Chattanooga, Tenn., has recently been organized by Walter Crafts, T. M. Girdler, of the Atlanta Steel Co., and others. This concern will install an electric steel furnace, of either the Heroult or Girod type, for the production of electric steel castings, ranging in weight from one pound to several tons. Electric power will be obtained from a large hydro-electric plant now being built on the Tennessee river by the Chattanooga & Tennessee River Power Co.

The Mt. Vernon Car Mfg. Co., Mt. Vernon, Ill., will erect a new plant which, among other departments, will include a machine shop, 75 x 100 feet, and a pattern shop, 60 x 100 feet.

The Union Iron Works, Detroit, have been incorporated with $30,000 capital, and will erect a plant at Rivard street and Harper avenue, comprising a two-story building, 42 x 96 feet, and a brass foundry, 32 x 70 feet. The company will engage in the manufacture of a general line of brass castings, such as steam and gas fittings, automobile parts and specialties.

The Henry & Scheible Co., Cleveland, furnace builder, has purchased the Ferro Steel Register plant at Chagrin Falls, O., and will fit it up for foundry purposes. Considerable foundry equipment will be required.

The Racine Foundry Co., Racine, Wis., will engage in the manufacture of iron, brass and aluminum castings for the automobile trade. A foundry, 60 x 125 feet, boiler shop, 30 x 100 feet, and machine shop, 40 x 100 feet, will be erected.

The Falk Co., Milwaukee, is installing a Stoughton side blow converter in its steel foundry, and the same will be placed in operation early this year. Five of these converters are now in use in various parts of the United States.

The plant of the Davison Foundry Co., Chicago, has been purchased by John W. Hubbard, president of Hubbard & Co., Pittsburg, manufacturer of shovels and railroad track tools. Additional property adjoining this plant has also been secured, and the Hubbard Steel Foundry Co., with a capital of $300,000 has been organized by Mr. Hubbard. It is the intention to erect additional buildings and two open-hearth furnaces, and the foundry will be equipped for the production of steel rolls and other steel castings of large section. John N. Allen, formerly with the Illinois Steel Co. and later with the Lackawanna Steel Co., Buffalo, has been appointed general manager.

The Erie Engine Works, Erie, Pa., has purchased a tract of 10 acres in that city, and will proceed at once with the erection of a new plant which will double its present capacity. These works will consist of an iron foundry, 135 x 440 feet; office building, 40 x 40 feet; power plant, 40 x 40 feet; store house, 40 x 80 feet; carpenter shop, 40 x 50 feet, and fireproof storage building, 55 x 104 feet. A yard crane runway, 40 x 200 feet, will be provided and the melting equipment of the new foundry will consist of two 66-inch cupolas. Two 30-ton cranes will be installed in the main bay of the foundry, and the yard will be served by a 10-ton crane. F. Felkel, 412 Fourth avenue, Pittsburg, is in charge of the work.

The Davenport Locomotive Works, Davenport, Ia., has completed plans for additions which will cost approximately $250,000. The buildings include pattern, blacksmith, machine and erecting shops.

The American Ornamental Iron & Bronze Co., Minneapolis, recently incorporated, will erect a plant at Bryn Mawr, Minneapolis, for the manufacture of ornamental iron and bronze work, both cast and wrought, such as stairs, grilles, gates, fences, etc. Frederick H. Wallis is secretary of the company, and Hubert Kelly is treasurer.

The Vulcan Iron Works, New Britain, Conn., will erect a foundry, 110 x 302 feet, at an estimated cost of $16,000.

The Malleable Iron Fitting Co., Brantford, Conn., is enlarging its plant by an addition to its steel foundry, 200 x 135 feet. An additional converter, as well as a small open-hearth furnace, will be installed. The malleable foundry will also be enlarged, and will be provided with a 25-ton reverberatory furnace.

The Orrville Pump & Furnace Co., Orrville, O., has recently been incorporated with $75,000 capital to take over the business of the Orr Foundry Co. and the Service Pump Co., Orrville, as well as the Razor Furnace Co., Barberton, O. The company now has under construction at Orrville a foundry building, 70 x 110 feet, a brick pattern shop, 40 x 70 feet, and a power plant, 30 x 60 feet.

The North Wales Machine Co., North Wales, Pa., is erecting a foundry and machine shop. This company manufactures grinding machinery, power hack-saw machines, etc.

The Comstock-Wellman Bronze Co., Cleveland, has been incorporated with $20,000 capital, to build a plant for the production of brass and bronze castings. The incorporators are C. W. & L. W. Comstock, and S. T., F. S., and J. A. Wellman.

The Keeler Brass Co., Grand Rapids, Mich., will erect a foundry building at an estimated cost of $1,500.

The Flour City Ornamental Iron Works, Minneapolis, Minn., will erect an extensive addition to its plant.

The R. N. Bassett Co., Shelton, Conn., manufacturer of brass goods, will erect an addition to its plant, four stories high, 60 x 100 feet.

The Southern Pipe & Foundry Co., South Knoxville, Tenn., plans doubling the capacity of its present plant by the addition of a new building, 250 x 400 feet.

The Laidlaw-Dunn-Gordon Co., Cincinnati, will erect an addition to its foundry, 162 x 120 feet. The center aisle will be 54 feet wide and will be served by two 10-ton traveling cranes. The structure will be sufficiently heavy to permit the subsequent installation of 25-ton cranes. The side aisles will be approximately 32 feet wide, and will be served by hand trolleys with air hoists. The yard will be served by a traveling crane, having a 6-foot span. An additional 72-inch cupola is also being installed. The new building will be of steel frame construction., with brick walls and composition roof.

The West Side Foundry Co., Troy, N. Y., which manufactures gray iron and ornamental castings, is erecting an addition to its plant, 150 feet long, and the increased facilities will provide work for 25 to 30 additional molders.

The Detroit Stove Works, Detroit, will erect a new factory building, 66 x 184 feet, five stories high.

The Holyoke Motor Foundry Co., Holyoke, Mass., will erect a new foundry building, 80 x 88 feet.

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